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Assessment of Oral Health Literacy and Oral Health Status among Primary School Teachers in Yangon Region

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Abstract **- Oral cavity is the portal into the body and keeping it disease free is essential for maintaining general health. To improve oral health of the people, important strategy is giving oral health education. However, the effectiveness of health education is varied among different population groups which may be due to the level of health literacy. Studies indicated that people with poor health literacy skills had associated with poor health knowledge, unhealthy behaviors, low level of preventive service uses, poor health status and high hospitalization rate. The aim of this study was to assess the level of oral health literacy (OHL) and oral health status among primary school teachers from East District, Yangon Region. Cross-sectional, analytic, school-based, non-intervention type of study was carried out among 214 (1 male and 213 female) primary school teachers in 2018. Data concerning socio-demographic characteristics, level of OHL, dental caries and oral hygiene status were determined. The present sample was mostly represented urban population and almost half of teachers had more than 25-year experience. Mean OHL score was 16.72 (SD 2.96) (Range 0 - 24) demonstrated that the present sample had moderate level of OHL. In concern with clinical status, mean number of DMF-T was 4.87 (SD 5.04) and prevalence of dental caries was 78.0%. This study showed high level of caries prevalence and mean DMF-T value than those from other studies. Low level of plaque score, mean PI score 0.64 (SD 0.48) (range 0 - 3) demonstrated that teachers had favorable oral hygiene status. There was no relationship between dental caries data and OHL score but people with high OHL score had low plaque score in this study. OHL questionnaire used in this study had some sensitivity on the assessment of oral hygiene status but further researches were needed. The role of primary school teachers is important not only on their schoolchildren educational attainment but also establishing good behavior among students including oral hygiene practices. Therefore, the level of OHL among teachers may have greater influence on schoolchildren' life. The present study recommended that school oral health promotion program should be maintained and strengthened for students and teachers to ensure future development of upcoming generation of Myanmar.**

Keywords; Oral health literacy, Dental caries status, Oral hygiene status, Primary school teachers

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Introduction

Oral cavity includes not only the teeth, gums and supporting tissues but also hard and soft palate, mucosal lining of mouth and throat, tongue, lips, salivary glands muscles of mastication and jaws. The oral cavity is the portal into the body and keeping it disease free is essential for maintaining adequate nutrition, communication and positive self-esteem (Chalmers, 2003). Moreover, several studies discussed that the presence of relationship between oral and general health emphasizing the importance of keeping optimum oral health for getting well-being throughout life.

To improve oral health of the people, one of the various strategies is giving oral health education that can be conveyed in many ways, such as using print materials, internet, audio-visual aids and lecture (Doak *et al*., 1996). However, the effectiveness of health education is varied among different population groups. Researchers reported that it might be due to the capability of an individual to comprehend and apply the health facts in their daily life. One factor influencing such capability is the level of health literacy (Davis, 1998). A growing body of research indicates that people with poor literacy skills had associated with poor health knowledge, unhealthy behaviors, low usage of preventive services, poor health status and high hospitalization rate (DeWalt *et al.*, 2004).

Broadly, health literacy refers to skills that establish a person's motivation and ability to access, process and use information to promote and maintain good health (Nutbeam, 1998). Amalraj *et al*. (2009) also referred health literacy as the ability to read and comprehend appointment slips and other clinical materials and follow oral and written instruction. Based on these definitions, a model of health literacy including three levels was proposed: functional or basic literacy (reading and writing skills for everyday life), communicative or interactive literacy (cognitive and literacy skills combined with social skills) and critical literacy (empowerment to handle information and have control over situations) (Nutbeam, 2000).

Many health literacy instruments were developed and early instruments mostly focused on reading and writing skills, such as Rapid Estimate of Adult Literacy in Medicine (REALM) and Test of Functional Health Literacy in Adults (TOFHLA). Over the last decade, researchers incorporated writing, numeracy, speaking, listening and understanding of health care system as key focal areas in developing health literacy tools (DeWalt *et al.*, 2004; Chinn, 2011).

Oral health literacy (OHL) refers to "the degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions and act on them" (Lee *et al.*, 2012). Oral Health literacy skills are conceived as an important asset for maintaining or improving one's oral health. So, low oral health literacy skill may be a barrier in the assessment of health information, health care, medications use and the prevention of oral diseases (Nutbeam, 2008).

Oral health literacy tools are developed based on two main strategies, word recognition and reading comprehension. Available tools are Rapid Estimate of Adult Literacy in Dentistry-30 (REALD-30), Test of Functional Health Literacy in Dentistry (TOFHLiD), Oral Health Literacy Instrument (OHLI), Oral Health Literacy

Adult Questionnaire (OHL-AQ), Comprehensive Measure of Oral Health Knowledge (CMOHK) and Health Literacy in Dentistry-14 (HeLD-14) (Dickson-Swift *et al.*, 2014).

A number of studies showed that OHL, as a barrier to health-related action and a contributor to poorer oral health status, is of particular interest and concern for all population groups. In Myanmar, oral health care services are provided by both private and public or government providers. The Ministry of Health and Sports is taking the responsibility of providing comprehensive oral health care services as well as dissemination of oral health education in all hospitals and school health teams (Health in Myanmar, 2014). Global School Health Initiative (1995) (WHO, 1995) seek to mobilize and strengthen health promotion and education activities at the local, national, regional and global levels aiming to promote the health standard of the entire student youths, the skills and knowledge needed for adoption of healthy lifestyle.

The family, particularly mothers are the primary people affecting both general and oral health of children as mothers' oral health literacy and behaviors greatly influence their children (Choi & Ahn, 2012). In addition, the second most important people, primary school teachers' OHL might also have influence over their students' oral health behavior (Jagan *et al.*, 2018). School is the basic institution in every society and offers the possibility to improve the general health including oral health not only of the school children but also of the whole community. The period of primary education is the most important not only for the individual child's life but also the future development of the entire nation.

Growing recognition of the importance regarding the association between OHL and the effectiveness of oral education program, afterwards oral health status of the individuals led to incorporate oral health literacy measures in dental public health research area. Regarding health literacy studies in Myanmar, Win Myint Oo *et al.* (2015) reported that majority of adult population (40.3%) residing in one State and five Regions had intermediate level of health literacy and it was significantly related to detrimental habits such as smoking and alcohol drinking. Other population groups like schoolchildren as well as school teachers should be assessed their OHL status for promoting oral health in the country.

There is scarce amount of data concerning the level of oral health literacy among population subgroups in Myanmar. Although school oral health promotion program is carried out and strengthening all over the country, some limitations like lacking preventive program and untreated oral diseases among schoolchildren might still be existed. Assessment of OHL status among primary school teachers may have significant inputs for further implementation of school oral health care services.

Persons other than parents and caregivers, who spend a considerable time with the children, are primary school teachers. Thus, levels of OHL of primary school teachers may have a substantial effect on oral health status of their students. The influence of primary school teachers is vital over their schoolchildren oral health and future development of healthy mouth and body of individual student as well as upcoming generation of the entire nation. Therefore, the present study was carried out to assess the level of oral health

literacy among primary school teachers in Yangon Region.

Materials and Methods

A cross-sectional, descriptive, school-based, non-intervention type of study was carried out in Thingangyun Township, East District, Yangon from July 2018 to October 2018. After getting agreement from the respective educational authorities, twenty-two Basic Education Schools were selected randomly and explained the procedure to the heads of the schools. With the help of the school authority, all eligible primary school teachers were selected according to the inclusion criteria and asking for the consent. The study included 214 primary school teachers.

After getting the consent, the investigators asked a participant about socio-demographic data and OHL questionnaire (including 20 questions for oral health knowledge and 4 questions for numeracy skill which was modified from TWO established OHL instruments, CMOHK and OHL-AQ) by using face to face interview method in a prepared room. To prevent any disturbances from their teaching schedule, interview section was carried out during their lunch-time hour.

Figure 1. OHL Questionnaires data collection of primary school teachers

Figure 2. Clinical data collection of primary school teachers

All participants were examined to assess dental caries status using decayed, missing and filled teeth index (DMF-T index) applying WHO (2013) criteria and oral hygiene status by Plaque Index (Silness & Loe, 1964; John, 2003). The infection control guidelines recommended by WHO (2013) were used throughout. Disposable examination set was used for each teacher. The examination was performed by two examiners and trained recorders under natural day light in a prepared room.

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Statistical Analysis

Collected data were cleansed and entered in Statistical Package for Social Sciences (SPSS) (version 22.0). Data analysis was done accordingly. The continuous variables were expressed by means and standard deviations and the categorical variables were described by frequencies and percent and analyzed by Chi-square test.

Results

In this study, 214 primary school teachers (1 male and 213 female) (mean age 46.1 year, range 22 to 60 year) were participated. Regarding ethnicity, 93% reported as Bamar. The socio-

demographic attributes i.e., marital status, educational level, designation and years in service were shown in Table 1. The present sample was mostly represented urban population and more than half of the participants (65.4%) were Junior Assistant Teachers (JAT). Almost half of teachers had more than 25-year experience.

Table 1. Distribution of primary school teachers by socio-demographic attributes (n=214)

Socio-demographic attributes	Primary school teacher n (%)
Ethnic Group	
Bamar	199 (93.0)
National races	9 (4.2)
Other	6 (2.8)
Marital Status	
Married	123 (57.5)
Single	91 (42.5)
Designation	
Junior Assistant Teacher (JAT)	140 (65.4)
Primary Assistant Teacher (PAT)	74 (34.6)
Service	
≤15 Years	80 (37.4)
16-25	24 (11.2)
> 25 Years	110 (51.4)

Relating to the oral health literacy data, mean number of total OHL score was 16.72 (SD 2.96) (range 0 - 24), where mean oral health knowledge score was 13.79 (SD 2.42) (range 0 - 20) and mean score of 2.93 (SD 1.13) (range 0 - 4) for numeracy skill (Table 2). The present sample might have satisfactory level of OHL. Only 10.7% of total sample was in low OHL category where score 12 as a cut-off point.

Table 2. OHL score of primary school teachers (n=214)

OHL Data	Mean (SD)
Oral Health Knowledge (0-20)	13.79 (2.42)
Calculation Skill (0-4)	2.93 (1.13)
Total OHL Score (0-24)	16.72 (2.96)

In concern with clinical status, mean number of DMF-T was 4.87 (SD 5.04) and prevalence dental caries was 78.0%. Primary school teachers had high level of caries prevalence and mean DMF-T (Table 3). In addition, low level of plaque score, mean PI score 0.64 (SD 0.48) (range 0 - 3) demonstrated that teachers had favorable oral hygiene status.

Table 3. Clinical data of primary school teachers (n=214)

Dentition status	Mean D (SD)	1.93 (2.09)
	Mean M (SD)	2.43 (4.04)
	Mean F (SD)	0.50 (1.05)
	Mean DMFT (SD)	4.87 (5.04)
	Caries prevalence	78%
Plaque Index	Mean plaque score (SD)	0.64 (0.48)

Table 4. Relationship between OHL and clinical data of primary school teachers (n=214)

	Mean DMF-T	**Mean PI**	**Caries Prevalence n (%)**
Low OHL (≤12) (n=23)	3.83 (3.39)	0.97 (0.63)	19 (82.6)
High OHL (>12) (n=191)	4.99 (5.19)	0.60 (0.45)	148 (77.5)
***p* value**	0.15 *	0.01 **	0.58 ***

**p*>0.05 (Independent sample t- test)
***p*<0.05 ((Independent sample t- test)
****p*>0.05 (Chi-square test)

Table (4) represented the relationship between OHL score and clinical data. There was no relationship between dental caries data and OHL score but people with high OHL score had better oral hygiene level, low plaque score in this study.

Discussion

The dental public health professionals recognized the importance of association between OHL and the effectiveness of oral education program, afterwards oral health status of the individuals have led to incorporate the oral health literacy instruments in dental researches. The present study aimed to assess the level of OHL and relationship with oral health status among primary school teachers in the East District, Yangon Region. Since the study was carried out in Thingangyun Township, the present sample was mostly represented to urban adult population.

Although the present sample was targeted to teachers who taught primary schoolchildren, almost two third of teachers were designated as JAT. Moreover, more than half of them had 25 years and more services. Those data pointed out those teachers who participated in this study were seemed to have better and ample amount of teaching experiences.

Concerning oral health literacy level, moderate level of OHL score, both oral health knowledge and numerical skill scores, was observed among teachers. There was no association between OHL score with service years and designation of primary school teachers in this study. Primary school teachers who participated in this study had satisfactory level of OHL which will have definite advantages over the training of students in their respective schools. However, dental research using OHL measures should be assessed further.

The present study demonstrated that dental caries prevalence was 78.0% with mean DMF-T of 4.87 where missing was a dominant portion. Since the sample consists of only one male teacher, gender variation cannot be calculated. According to WHO data, the level of dental caries of primary teachers was in very low category (DMF-T < 5.0) for adult population (35 -44) age group. The present findings were much higher value of prevalence and DMF-T than Pathfinder survey where prevalence was 63.65% and mean DMF-T was 2.96 (Myanmar Dental Association, 2007). Low mean score of Plaque Index (0.64) expressed that teachers form this study had satisfactory oral hygiene level.

There was no relationship between OHL score and dental caries data in the present study. Mean plaque score of all participants was low among teachers and seemed to have favorable oral hygiene level among participants. The statistically significant association was

found between OHL score and plaque score, teachers with high OHL score had better oral hygiene level, less plaque score in this study. This finding demonstrated that OHL questionnaire used in this study had some advantage of sensitivity on determination of oral hygiene status.

Since the role of primary school teachers is important not only on their schoolchildren educational attainment but also establishing good behavior among students including oral hygiene practices, the level of OHL among teachers may have greater influence over schoolchildren' life.

Conclusion

Teachers who participated in this study had satisfactory level of OHL and low plaque score might point out that current situation of oral health knowledge, attitude and behavior among primary school teachers were acceptable. However, maintaining and strengthening of oral health promotion program is still needed not only for students but also for teachers in Myanmar which will ensure future development of healthy mouth and body of individual student as well as upcoming generation of the entire nation.

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The authors declare there is no potential conflict of interest.

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References

[1] Amalraj, S., Naeim, A., Nguyen, C. & Starkweather, C. (2009). Health literacy, communication, and treatment. *Oncology*, 23(4), pp. 369-375.

[2] Chalmers, J.M. (2003). Oral health promotion for our ageing Australian population. *Australian Dental Journal*, 48 (1), pp. 2-9.

[3] Chinn, D. (2011). Critical health literacy: A review and critical analysis. *Social, Science & Medicine*, 73(1), pp. 60-67.

[4] Choi, H.E. & Ahn, H.Y. (2012). Effects of Mothers Involved in Dental Health Program for Their Children. *Journal Korean Academic Nursing*, 42(7), pp. 1050-1061.

[5] Davis, T.C., Michiclutte, R., Askov, E.N., Williams, M.V. & Weiss, B.D. (1998). Practical Assessment of Adult Literacy in Health care. *Health Education & Behavior*, 25(5), pp. 613-624.

[6] Dewalt, D.M., Darren, A. & Nancy, D. *et al*. (2004). Literacy and health outcomes: A systematic review of the literature. *Journal of General Internal Medicine*, 19(12), pp. 1228-1239.

[7] Dickson-Swift, V., Kenny, A., Farmer, J., Gussy, M. & Larkins, S. (2014). Measuring oral health literacy: a scoping review of existing tools. BMC Oral Health, 14(148), pp. 1-13.

[8] Doak, C.C., Doak, L.G. & Root, J.H. (1996). *Teaching Patients with* Low *Literacy Skills*, 2nd Edition. J.B. Lippincott, Philadelphia.

[9] Jagan, P., Fareed, N. & Battur, H. *et al*. (2018). Conceptual knowledge of oral health among school teachers in South India, India. *Eur J Dent*, 12(1), pp. 43-48.

[10] Lee, J.Y., Divaris, K., Baker, A.D., Rozier, R.G. & Vann, W.F. (2012). The Relationship of Oral Health Literacy and Self-Efficacy with Oral Health Status and Dental Neglect. *American Journal Public Health*, 102, pp. 923-929.

[11] Ministry of Health, The Republic of the Union of Myanmar (2014). Health in Myanmar. www.moh.gov.mm. [Accessed 11 May 2018].
[12] Myanmar Dental Association (2007). Results of pathfinder oral health survey (2006-2007). Proceedings of *Myanmar Dental Conference*, 2007.
[13] Nutbeam D. (1998). Health promotion glossary. *Health Promotion International Journal*, 13(4), pp. 349-364.
[14] Nutbeam, D. & Kickbusch, I.S. (2000). Advancing health literacy: a global, 15(3), pp. 183-184.
[15] Nutbeam, D. (2008). The evolving concept of health literacy. *Social Science & Medicine*, 67, pp. 2072-2078.
[16] Win Myint Oo, Pa Pa Soe & Kay Thi Lwin (2015). Status and determinants of health literacy: a study among adult population in selected areas of Myanmar. *International Journal Community Medical Public Health*, 2(3), pp. 318-322.
[17] World Health Organization (1995). School and youth health. www. Who.int/school youth health/gshi/en. [Accessed 12 May 2018].

Assessment of Oral Cancer Awareness among Undergraduate Yangon Dental Students

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Abstract **- Oral cancer is a well-known health problem with a serious impact on social, economic and quality of life. Early diagnosis of oral cancer greatly decreases morbidity and mortality, however the identifiable clinical features for early lesions, may remain undetected in the early stages because of the multiple factors including dentist attitude and knowledge. Thus, the aim of this study was to investigate the level of knowledge, attitude and awareness among the dental university students regarding oral cancer. A cross-sectional, university-based, descriptive study was carried out among 360 undergraduate dental students from University of Dental Medicine, Yangon in 2019. A pretested questionnaire consisting of 21 items was used to obtain information about knowledge on risk factors and diagnostic facts of oral cancer, attitude of dental students towards oral cancer. All clinical and preclinical undergraduate dental students answered the questionnaire and the responses were analyzed with descriptive analyses. Regarding the knowledge about oral cancer risk factors, the largest number of preclinical and clinical year students was able to identify tobacco (98.1%), betel quid chewing (97.2%), prior oral lesions (80.3%) and viral infection (73.1%) as risk factors. Higher percentage of clinical year students (84.4%) could recognize alcohol usage as a risk factor compared to preclinical year students (52.8%) (p<0.001). In contrast, less than half (46.1%) of the study population could recognize the clinical presentation of prior oral cancer lesion as small, painless and white area. Regarding attitudes towards oral cancer, both groups showed higher scores (93.1%) in giving information to patients about risk factors of oral cancer. This study revealed the preclinical students had lower knowledge and attitudes towards oral cancer risk factors and diagnosis procedure than clinical students. Knowledge of oral cancer, in particular its clinical presentation, needs to be reinforced throughout the under-graduate dental course to enable raising awareness and making an early diagnosis of lesions.**

Keywords; dental students, knowledge, oral cancer awareness

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Introduction

Cancer is a universal non-communicable disease that affects people without regard to race, gender, socio economic status or culture. It can occur at any site or tissue of the body and involves any type of cells (Park, 2013).

The term oral cancer encompasses all malignancies which originate in the oral tissues. Primary tumors of the oral cavity may arise from epithelium, minor salivary glands or sub mucous tissues, tumors of dental origin, bone tumors and tumors of neuromuscular origin are also common. The tongue, alveolar ridges, gingiva, buccal sulcus, buccal mucosa are some common sites of carcinoma (Nettina & Brunner, 2006).

Oral cancers were the seventh most commonly occurring cancer and, in terms of mortality, the ninth deadliest by cancer site in the world as stated by World Cancer Report 2014 (Stewart & Wild, 2014). Tobacco and alcohol uses are the primary risk factors for oral cancer in patients over the age of 45 years (Tomar, 2016). Low consumption of fruits and vegetables, immunodeficiency exposure to the sun, socio-economic status, and infection with human papilloma virus (HPV) are some of the other risk factors for oral cancers (Düzlü *et al*., 2016). Previous studies in literature revealed that the incidence of oral cancer increases with smoking tobacco, alcohol consumption and older age (Neville & Day, 2002).

A majority of oral cancer is detected at advanced stages when more aggressive therapies are needed that may impact on the function of the oral cavity, and produce facial disfigurement affecting the patient's quality of life (Keser & Pekiner, 2018). Dentists are qualified to opportunistically screen for oral cancer and further to provide preventive advice and counselling interventions during routine examinations. It is vital that dentists have accurate knowledge about oral cancer to identify individuals at risk, examine the mouth to document tissue changes and provide appropriate interventions, thus potentially contributing to the reduction in oral cancer incidence, morbidity and mortality (Decuseara, 2011).

There are rapidly increasing numbers of oral pre-cancer and cancer patients seeking treatment at University of Dental Medicine, Yangon in recent years. Hence, it is essential to introduce knowledge and attitude in training program of dental students as early as possible. The findings of this study will provide the basic knowledge level and background nature of dental students related to oral cancer and evaluated the comparison between oral cancer risk factors and diagnostic concepts among the different levels of dental students. If there is a limited knowledge related to awareness of oral cancer in university students, further plan may be needed to implement in the learning/teaching process. Thus, the present study must be implemented with the aim to assess the knowledge, attitude and awareness levels among the dental university students regarding oral cancer.

Materials and Methods

A cross-sectional, descriptive study was carried out between the months of June to November 2019. A total of 360 undergraduate dental students studying in first year to final year in University of Dental Medicine and interns (sixty students in each class) were randomly selected with proportionate stratified random sampling method. A self-administered structured questionnaire with closed ended questions was used to collect data regarding knowledge and attitudes of dental students regarding oral cancer. The questionnaire was adapted, validated and modified from the study of Keser and Pekiner (2018) and pretested among 10% of study population. In this study, the questionnaires were divided

into four main parts. The first part contained the socio-demographic data such as age, gender, educational level of the students. The second part was designed to measure knowledge of dental students about oral cancer risk factors (8 items). The following third part was aimed to measure knowledge of dental students about diagnosis of oral cancer (5 items). The last part was formulated to estimate the attitude level of dental students regarding oral cancer (8 items). The questionnaire was set in English with a 3-point Likert response scale ranging from code 3 (Yes), code 2 (don't know) and code 1 (No).

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Statistical Analysis

Data were analyzed by using statistical software (SPSS) (version 20.0). The response format was based on 3-Point Likert scale for knowledge and attitude. Level of significance was fixed at $p<0.05$. Frequencies, means and standard deviations as part of descriptive statistics were used to describe the data. Chi-square test was performed to assess whether the knowledge and attitude varies according to socio-demographic characteristics and level of education of students regarding oral cancer.

Results

There were 360 students participated in this study; 180 were preclinical year students (1^{st}, 2^{nd} and 3^{rd} year students) and 180 were clinical year students (4^{th}, final year students and interns). Among preclinical year students, 96.7% was between 15 to 20 years of age and 3.3% was 21 to 25 years. Among clinical year students, 24.4% was from 15 to 20 years age group, 74.4% was 21 to 25 years old and 1.1% was from 26 to 30 years. Out of 360 students, 56.94% was male and 43.06% was female (Table 1).

Table 1. Age and sex distribution of undergraduate dental students (n=360)

Categories	Groups	Prelcinical year	Clinical year
Age (in years)	15-20	174 (96.7%)	44 (24.4%)
	21-25	6 (3.3%)	134 (74.4%)
	26-30	-	2 (1.1%)
Gender	Male	92 (51.1%)	113 (62.8%)
	Female	88 (48.9%)	67 (37.2%)

Regarding the knowledge about oral cancer risk factors, the largest number of preclinical and clinical year students identified tobacco (98.1%), betel quid chewing (97.2%), prior oral lesions (80.3%) and viral infection, eg. Human Papilloma Virus (73.1%) as risk factors. Only 40.3% of preclinical and clinical year students considered low consumption of fruits and vegetables as a risk factor and 39.2% could correctly identify an old age as a risk factor for oral cancer. The knowledge about oral cancer risk factors in preclinical and clinical students was almost similar. However, clinical students showed a significantly higher percentage (91.7%) than preclinical year students (53.9%) when identifying ultraviolet exposure as a risk factor ($p<0.001$). Higher percentage of clinical year students (84.4%) identified alcohol use as a risk factor than preclinical year students (52.8%) ($p<0.001$) (Table 2).

Table 2. Percentage of dental students who identified oral cancer risk factors (n=360)

Knowledge about oral cancer risk factors		Preclinical years n (%)	Clinical years n (%)	Total n (%)	*p*-value
1. Do you consider use of tobacco as a risk factor?	Yes	175 (97.2)	178 (98.9)	353 (98.1)	0.329
	No	3 (1.7)	2 (1.1)	5 (1.4)	
	Don't know	2 (1.1)	0 (0.0)	2 (0.6)	
2. Do you consider low consumption of fruit and vegetable as a risk factor?	Yes	81 (45.0)	64 (35.6)	145 (40.3)	0.005*
	No	67 (37.2)	97 (53.9)	164 (45.6)	
	Don't know	32 (17.8)	19 (10.6)	51 (14.2)	
3. Do you consider betel quid chewing as a risk factor?	Yes	171 (95.0)	179 (99.4)	350 (97.2)	0.035*
	No	2 (1.1)	0 (0.0)	2 (0.6)	
	Don't know	7 (3.9)	1 (0.6)	8 (2.2)	
4. Do you consider ultraviolet exposure as a risk factor?	Yes	97 (53.9)	165 (91.7)	262 (72.8)	<0.001*
	No	43 (23.9)	6 (3.3)	49 (13.6)	
	Don't know	40 (22.2)	9 (5.0)	49 (13.6)	
5. Do you consider viral infection (e.g. Human Papilloma Virus) as a risk factor?	Yes	112 (62.2)	151 (83.9)	263 (73.1)	<0.001*
	No	19 (10.6)	20 (11.1)	39 (10.8)	
	Don't know	49 (27.2)	9 (5.0)	58 (16.1)	
6. Do you consider alcohol use as a risk factor?	Yes	95 (52.8)	152 (84.4)	247 (68.6)	<0.001*
	No	77 (42.8)	23 (12.8)	100 (27.8)	
	Don't know	8 (4.4)	5 (2.8)	13 (3.6)	
7. Do you consider prior oral cancer lesion as a risk factor?	Yes	126 (70.0)	163 (90.6)	289 (80.3)	<0.001*
	No	9 (5.0)	6 (3.3)	15 (4.2)	
	Don't know	45 (25.0)	11 (6.1)	56 (15.6)	

*Chi-square test

Table (3) showed the knowledge about oral cancer diagnosis procedure. Clinical students had significantly higher scores (86.1%) in indicating erythroplakia and leukoplakia are precancerous lesions compared to preclinical years (19.4%) (p<0.001). Less than half (46.1%) of the study population could recognize the clinical presentation of prior oral cancer lesion as small, painless and white area. Among them clinical year students have significantly higher knowledge level compared to the students from preclinical years (p<0.001).

Table 3. Percentage of dental students who gave correct responses to oral cancer diagnostic knowledge items (n=360)

Knowledge about diagnosis of oral cancer	Preclinical years n (%)	Clinical years n (%)	Total n (%)	*p*-value
1. The most common site for oral cancer is mucous membrane check/lip/gum and back of the tongue	137 (76.1)	128 (71.1)	265 (73.6)	<0.001*
2. Two lesions most likely to be precancerous are leukoplakia and erythroplakia	35 (19.4)	155 (86.1)	190 (52.8)	<0.001*
3.The most common form of oral cancer is squamous cell carcinoma	82 (45.6)	172 (95.6)	254 (70.6)	<0.001*
4.Age group more likely to be diagnosed with oral cancer is 40-60 years	151 (83.9)	152 (84.4)	303 (84.2)	0.001*
5.Clinical presentation of a prior oral cancer lesion is small, painless white area	50 (27.8)	116 (64.4)	166 (46.1)	<0.001*

*Chi-square test

Concerning with attitude about oral cancer (Table 4), more than 90% of the study population had positive attitudes regarding informing the suspected oral lesion when they find in patients' mouth, advise the proper oral hygiene during oral cancer treatment, and giving information to patients about risk factors of oral cancer (91.4%, 91.9% and 93.1% respectively). In addition, 87.2% of the study population agreed that they will inform the signs and symptoms of oral cancer to their patients. However, less than 40% of preclinical year students agreed that they had been adequately trained to perform an oral cancer examination and lymph nodes palpation (37.2% and 32.2% respectively).

Table 4. Percentage of dental students' responses to attitude questions (n=360)

Attitude of dental students about oral cancer		Preclinical years n (%)	Clinical years n (%)	Total n (%)	*p*-value
1. I inform the patients with suspicious oral lesions	Agree	157 (87.2)	172 (95.6)	329 (91.4)	0.011
	Disagree	4 (2.2)	3 (1.7)	7 (1.9)	
	Uncertain	19 (10.6)	5 (2.8)	24 (6.7)	
2. I advise oral cancer patient about the importance of proper oral hygiene during cancer treatment	Agree	162 (90.0)	169 (93.9)	331 (91.9)	0.289
	Disagree	4 (2.2)	4 (2.2)	8 (2.2)	
	Uncertain	14 (7.8)	7 (3.9)	21 (5.8)	
3. I advise patients to stop wearing the dentures during cancer treatment, even if there are no problem with fit or comfort	Agree	77 (42.8)	118 (65.6)	195 (54.2)	<0.001*
	Disagree	21 (11.7)	18 (10.0)	39 (10.8)	
	Uncertain	82 (45.6)	44 (24.4)	126 (35.0)	
4. I give information to oral cancer patients who are at risk for osteonecrosis after receiving high-dose radiation treatment to the mandible	Agree	113 (62.8)	156 (86.7)	269 (74.7)	<0.001*
	Disagree	9 (5.0)	4 (2.2)	13 (3.6)	
	Uncertain	58 (32.2)	20 (11.1)	78 (21.7)	
5. I give information to patients about risk factors of oral cancer	Agree	160 (88.9)	175 (97.2)	335 (93.1)	0.007*
	Disagree	11 (6.1)	2 (1.1)	13 (3.6)	
	Uncertain	9 (5.0)	3 (1.7)	12 (3.3)	
6. I inform the patients about the sign and symptoms of oral cancer	Agree	153 (85.0)	161 (89.4)	314 (87.2)	0.095
	Disagree	6 (3.3)	9 (5.0)	15 (4.2)	
	Uncertain	21 (11.7)	10 (5.6)	31 (8.6)	
7. I am adequately trained to perform an oral cancer examination	Agree	67 (37.2)	109 (60.6)	176 (48.9)	<0.001*
	Disagree	32 (17.8)	23 (12.8)	55 (15.3)	
	Uncertain	81 (45.0)	48 (26.7)	129 (35.8)	
8. I am adequately trained to perform patient's lymph nodes palpation	Agree	58 (32.2)	130 (72.2)	188 (52.2)	<0.001*
	Disagree	40 (22.2)	9 (5.0)	49 (13.6)	
	Uncertain	82 (45.6)	41 (22.8)	123 (34.2)	

*Chi-square test

Discussion

There are an estimated 657,000 new cases of cancers of the oral cavity and pharynx each year, and more than 330,000 deaths (WHO, 2020). Among oral cancer, oral squamous cell carcinoma is the most common oral malignant tumor, and it was believed that early detection in precancer stage is the best way of decreasing the mortality and morbidity rate of OSCC (Uti & Fashina, 2006). Hence, this study shed light on oral cancer awareness amongst undergraduate dental students, who are studying in University of Dental Medicine, Yangon.

Regarding age of the students, most of the students were younger than 25 years old as University of Dental Medicine used five years curriculum with one-year internship program, however very few students over 25 years represented the supplementary classes. Although a majority of the students correctly identified tobacco (98.1%) and betel quid chewing (97.2%) as a risk factor, 68.6% of them know that alcohol is one of the risk factors. An earlier study in Kuwait by Joseph *et al*. (2014) demonstrated the better knowledge of undergraduate dental students regarding tobacco (98.6%), alcohol (76.7%) and betel quid chewing (61.6%) as the principle risk factors. In 2018 Turkish study, the large number of the undergraduate dental students identified tobacco (98%), UV exposure (94.4%), and betel quid chewing (84.8%) as etiological factors for oral cancer (Keser & Pekiner, 2018). This similarity between previous studies and this study reflect the majority of dental students were well received on updated information about oral cancer risk factors.

In this study, 40.3% of preclinical and clinical year students considered low consumption of fruits and vegetables as a risk factor and 39.2% could correctly identify an old age as a risk factor for oral cancer. In the study conducted by Keser and Pekiner (2018), 85.4% of Marmara university undergraduate dental students considered low consumption of fruit and vegetable as a risk factor which revealed the knowledge of their students on that item was higher than the current study. Regarding older age as risk factor, study population of this study had low knowledge index than the studies of Joseph *et al*. (2014) and Keser and Pekiner (2018) where 69.9% and 62.1% of their study groups recognized older age as a risk factor. However, Soares *et al*. (2014) reported that only 28.57% of the Brazilian undergraduate dental students responded that age could be considered as risk factor, which was lowest among similar studies. The reason between different findings might reflected from the sampling methods and geographic variations.

Pertaining to knowledge about oral cancer, 70.6% of UDMY students answered that the most common form of

oral cancer is squamous cell carcinoma (SCC), however clinical year students (95.6%) responded significantly higher percentage than preclinical year students (45.6%). This finding was contrast to Soares *et al*. (2014) in which only 48.12% of their students described the SCC as the most common type of oral cancer. With regard to oral precancerous lesions, 52.8% of the UDMY students thought two lesions most likely to be precancerous are leukoplakia and erythroplakia. In the study by Josepth *et al*. (2014), 84.9% of the undergraduate students mentioned that erythroplakia and leukoplakia are the most common lesions associated with oral cancer. In contrast, an updated study by Keser and Pekiner in 2018 revealed 58.6% of the third and fifth grade students admitted that leukoplakia and erythroplakia are likely to be precancerous, which was similar to the current study. On the other hand, current study reported that clinical year students (86.1%) had significantly higher knowledge level regarding precancerous lesions to preclinical year students (19.4%). Thus, present findings alert the importance of introductory courses regarding oral cancer and precancers in preclinical year curriculum.

Early recognition of the most common clinical presentations of oral cancer is of utmost importance in the diagnosis of oral cancer. In this study, only 46.1% of the UDMY students recognized that clinical presentation of a prior oral cancer lesion is small, painless white area. Again, clinical year students (64.4%) had significantly higher level of knowledge regarding this question than preclinical year students (27.8%) ($p<0.001$). The study conducted Marmara University in Turkey showed that a low percentage of undergraduate dental students (28.8%) had sound knowledge on clinical properties of oral precancerous lesions (Keser & Pekiner, 2018). Hence, these figures are alarming for implementation of clinical suspicion of oral cancer throughout the undergraduate curriculum to enable awareness and early diagnosis. For instance, oral cancer examination form should be revised with well-known features of precancerous lesions and conditions.

Regarding to the attitude of study population regarding oral cancer, 35% of individual was uncertain about advising patients to stop wearing the dentures during cancer treatment. The rate of participation of clinical year students in performing oral cancer examination and lymph nodes palpation was found to be statistically significantly higher than that of preclinical year students ($p<0.001$). Less than 40% of preclinical year students mentioned that they were adequately trained to perform an oral cancer examination and lymph nodes palpation (37.2% and 32.2% respectively). In the study of Keser and Pekiner (2018), very few respondents agreed that they were well trained for an oral cancer examination and lymph node palpation (16.2% and 23.2% respectively). The result of the current study highlighted the importance of introductory skill learning teaching program in addition to routine repetitive teaching in early clinical year students.

Conclusion

The dental students who are being clinically trained at their fourth, final years and internship are the future dentists who will join the workforce in coming years. So, it is vital to recognize their level of awareness in oral cancer. Although the clinical students showed higher percentage of knowledge and

attitude level regarding oral cancer risk factors and diagnostic procedures than preclinical students, they were still failed to correctly identify of other risk factors such as poor nutrition, older age as well as clinical presentation of prior oral cancer lesions and attitude about oral cancer screening procedures. Thus, it can be concluded that this study recommended to modify structured learning teaching program regarding oral cancer and precancer in undergraduate courses. It is strongly suggested that knowledge of oral cancer, in particular its clinical presentation, needs to be reinforced throughout the undergraduate course especially to preclinical year dental students to enable raising awareness of oral cancer.

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The authors declare there is no potential conflict of interest.

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References

[1] Nettina, S.M. & Brunner, L.S. (2006). *Lippincot Manual of Nursing Practice*. 8th Edition. Jaypee brothers Medical Publishers, India.

[2] Daniel, W.W. & Cross, C.L. (2013). *Biostatistics: A Foundation for Analysis in the Health Sciences*. 10th Edition. John Wiley & Sons, Inc, United States of America.

[3] Decuseara, G. (2011). Oral Cancer knowledge, practice and opinions of dentists in Ireland. *Journal of the Irish Dental Association*, 57(4), pp. 209-214.

[4] Düzlü, M., Karamert, R., Bakkal, F.K., Cevizci, R., Tutar, H., Zorlu, M.E. *et al*. (2016). The demographics and histopathological features of oral cavity cancers in Turkey. *Turk J Med Sci*, 46, pp. 1672-1676.

[5] Joseph, B.K., Sundaram, D.B. & Ellepola, A.N.B. (2014). Assessing oral cancer knowledge among undergraduate dental students in Kuwait University, *J Canc Educ*, 30(3), pp. 414-420.

[6] Keser, G. & Pekiner, F.W. (2018). Assessing Oral Cancer Awareness Among Dental students. *J Cancer Educ*, 34(3), pp. 512-518.

[7] Neville, B.W. & Day, T.A. (2002). Oral cancer & precancerous lesions. *CA Cancer J Clin*, 52, pp. 195-215.

[8] Park, K. (2013). *Park's Text Book of Preventive and Social Medicine.* 22nd Edition. Jabalpur: M/S Banarsidas Bhanot Publisher, India.

[9] Soares, T.R.C., Carvalho, M.E.D.A., Pinto, L.S.S., Falcao, C.A., Matos, F.T.C. & Santos, T.C. (2014). Oral cancer knowledge and awareness among dental students. *Braz J Oral Sci*, 13(1), pp. 28-33.

[10] Stewart, B.W. & Wild, C.P. (2014). *World Cancer Report 2014*. International Agency for Research on Cancer, Lyon.

[11] Tomar, S.L. (2016). Dentistry's role in tobacco control. *J Am Dent Assoc*, 132, pp. 30S-35S.

[12] Uti, O.G. & Fashina, A.A. (2006). Oral cancer education in dental schools: knowledge and experience of Nigerian undergraduate students. *J Dent Educ*, 70, pp. 676-680.

[13] World Health Organization. (2020). *Oral Cancer*. https://www.who.int/cancer/prevention/diagnosis-screening/oral-cancer/en [Accessed 2 May 2020]

Push-Out Bond Strength of Three Resin Based Root Canal Sealers

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Abstract - **Three dimensional filling of entire root canal system prevents ingress and egress of microorganisms or their by-products through coronal, apical and lateral pathways and thus leads to success of endodontic treatment. This study determined and compared push-out bond strength of three resin sealers; Adseal, AH Plus and RealSeal SE according to two age groups. Total 30 numbers of recently extracted, non-carious, single-rooted human teeth (15 teeth of age ≤30 years, 15 teeth of age ≥60 years) were selected for this study. Each experimental subgroup was consisted of 5 teeth. Root canals were prepared with #40-0.08 WaveOne file and obturated with matched single cone gutta-percha in combination with 3 tested resin sealers; epoxy resin based Adseal and AH Plus sealers and methacrylate resin based RealSeal SE sealer. Three serial slices of 2.00±0.05 mm thickness were cut perpendicular to their long axis starting from coronal portion using Isomet Linear Precision Saw. Fifteen slices from each experimental group have been obtained and then push-out test was subjected to a compressive load via a Universal Testing Machine and failure modes were analyzed under stereomicroscope at x20 magnification. Statistical analysis was made using Two-Way ANOVA and post-hoc multiple comparison was done by Turkey test. In this study, push-out bond strength of RealSeal SE was significantly higher than that of AH Plus sealer in the ≤30 years-age group. In the ≥60 years-age group, there was no statistically significant difference in push-out bond strength between tested sealers at all. The push-out bond strength of all tested sealers showed some degree of push-out bond strength values in both age groups. According to this study, although specimens filled with methacrylate resin based sealer, RealSeal SE has higher bond strength in younger age group, it can be assumed that structural changes of dentin with age has no impact on interfacial bond strength of either in negative or positive effects and leads to success of endodontic treatment.**

Keywords; push-out bond strength, root canal sealer

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Introduction

Complete, tridimensional, hermetic sealing of the root canal system prevents the entry of microorganisms or their by-products through both the coronal and apical pathways and thus it leads to success of endodontic treatment (Silver-Neto *et al*., 2007). Obturation of root canal system has historically been achieved with gutta-percha core filling

material and an appropriate root canal sealer, and they have been the material of choice for over 100 years (Sly *et al*., 2007). However, gutta-percha has no bonding properties to dentin regardless of the filling technique employed. Root canal sealers fill imperfections and increase the adaptation of gutta-percha cones. Nevertheless, it has been shown that the quality of the root canal filling depends mainly on the sealing capacity of the sealer (Cobankara *et al*., 2002).

Many attempts have been made to resolve this problem through variations in obturation techniques and materials (Epley *et al*., 2006). In recent years, obturating materials and sealers have been developed based on dentin adhesion technologies borrowed from restorative dentistry, in an attempt to seal the root canal system more effectively (Schwartz, 2006). Moreover, endodontic monoblocks have been generated to improve the quality of seal in root fillings and to strengthen roots (Hiraishi *et al*., 2005) by means of adhesion of filling materials to root canal walls (Tay & Pashley, 2007).

Resin based adhesive endodontic sealers have received considerable attention from endodontists due to their good physical, chemical and biological properties (Kardon *et al*., 2003; Zmener, 2004). Numerous studies have investigated and among them, a push-out test has been described to measure bond between sealer, canal wall and the core material (Sly *et al*., 2007). This test is intended to assess the bond strength of sealer and core material to the canal wall.

Physiologically, dentin undergoes an increase in mineral content with age caused by filling of the tubule lumens and in some instances, total obliteration of the tubules takes place (Tronstad, 1991). Moreover, with increasing age, dentinal tubule's diameter and permeability becomes diminished and the root dentin becomes transparent or sclerotic due to alteration of mineral content (Kinney *et al*., 2005). Since transparency is a common pathology in aged teeth, it is surprising that there have been no studies on bond strength of resin sealers to root canal dentin wall. The present work attempts to remedy this by determining bond strength of transparent root dentin versus young root dentin. This structural difference of dentin can make impact on interfacial bond strength either in a negative or positive effects.

It is hypothesized that the increased calcification of dentin structure in seniors may help to bond more effectively and prevent micro-leakage. On the other hand, dentinal structure of young people would have more permeability, larger and wider tubules with a lesser chance of effective bond. However, deeper penetration of resin tags inside the tubules could be expected as well. Therefore, in this study, the push-out bond strength of three resin sealers will be measured and compared with their according to two different age groups (young vs old).

Materials and Method

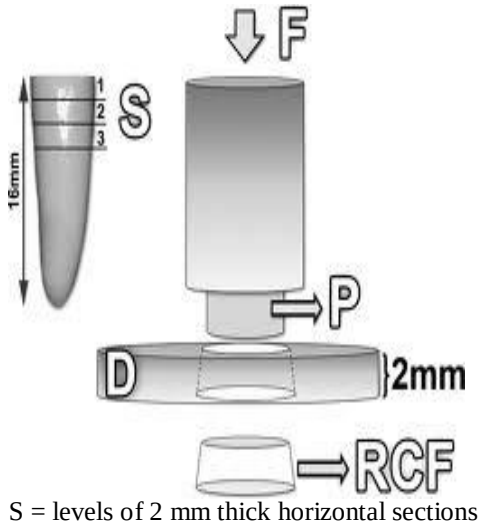
Total of 30 recently extracted, non-carious, single-rooted human teeth (15 teeth of age ≤30 years, 15 teeth of age ≥60 years) were selected for this study. All teeth were stored in 10% formalin immediately after extraction. The crowns of teeth were sectioned at the cementum-enamel junction using a low speed diamond saw (Buehler, Isomet, Lake Bluff, NY) under water coolant. A working length for each root was then established at 1 mm short of the apical

foramen using #15 K-file. Each canal was instrumented sequentially using K-file #15, #20 and #25 and #40-0.08 WaveOne files (Dentsply, Switzerland). During instrumentation root canals were irrigated with 2.5% NaOCl and upon completion, flushed with 3 ml of 2.5% NaOCl followed by 5 ml of distilled water. Then all teeth were stored in distilled water until obturation.

Fifteen roots of young age and 15 roots of senior age were randomly divided into three experimental groups for each age group. Each experimental subgroup consisted of 5 roots. Each root was given a code number and obturated with #40-0.08 WaveOne gutta-percha (Dentsply, Switzerland) in combination with 3 tested resin sealers; Adseal (Metabiomed, Korea), AH Plus (Dentsply, Germany) and RealSeal SE (Sybron Endo, USA) using matched single cone technique. After filling, the roots were stored at 37˚C and in a 100% humidity environment for 7 days.

Each root was embedded in acrylic resin and after setting 3 serial slices with 2.00±0.05 mm thickness were cut perpendicular to their long axis starting from coronal portion using a water-cooled precision saw (Isomet Linear Precision Saw, Model No. 112680, USA). Fifteen slices from each experimental group have been obtained for push-out tests. Then both apical and coronal aspects of the specimens were microscopically examined to confirm a circular shape. Each slice was coded and measured for the apical and coronal diameters of the obturated area using Image J software (Fiji 1.46). Finally, these slices were subjected to a compressive load via a Universal Testing Machine (Instron, UK, Version 8.30) at a crosshead speed of 1 mm/min using a 1 mm, 0.9 mm, and 0.8 mm diameter stainless cylindrical plungers (Figure 1). The plunger tip was contacted only the filling material and push-out force was applied in an apico-coronal direction until bonding failure occurs, which was manifested by extrusion of the obturation material and a sudden drop along the load direction. The maximum failure load was recorded in Newtons (N) and used to calculate the push-out bond strength in Megapascals (MPa) according to the following formula (Skidmore *et al*., 2006). Push-out bond strength (MPa) = N/A: where, N=Maximum load (N), A= Adhesion area of root canal filling (mm^2). The adhesion (bonding) surface area of each section was calculated as: Lateral surface area = $\pi(r_1+r_2)\sqrt{(r_1-r_2)^2+h^2}$; where π is the constant 3.142, r_1 and r_2 are the smaller and larger radii, respectively, and h is the thickness of the section in mm.

Failure modes were analyzed by examining each debonded specimen under stereomicroscope (Olympus) at x20 magnification. Failures were classified according to Teixeira *et al*. (2009) as; type I(a) (adhesive failure at the sealer-dentin interface), type I(b) (adhesive failure at the sealer-gutta-percha interface), type II (cohesive failure within the sealer or dentin) or type III (mixed failure; *i.e.*, failure in both the sealer and dentin).



S = levels of 2 mm thick horizontal sections
F = Direction of force
P = Cylindrical plunger
D = Root dentin cylinder
RCF = Root canal filling (sealer and core)

Figure 1. Schematic representation of push-out test (Adapted from Nagas *et al*., 2007)

Results

Means and standard deviations of the push-out bond strength of tested sealers are tabulated along with their ranges in Table 1 and Figure 2. In ≤30 years age group, the lowest bond strength was found in AH Plus sealer and in ≥60 years age group RealSeal SE showed the lowest. When these results were statistically analyzed by using Two-Way ANOVA, there was a statistically significant difference within the groups (p=0.029).

Sealers	≤30 years		≥60 years	
	Mean±SD	Range	Mean±SD	Range
Adseal (n=15)	1.48±1.17	0.17- 4.44	1.40±0.82	0.60 – 3.92
AH Plus (n=15)	1.25±0.62	0.01– 2.81	1.45±1.22	0.40 – 4.83
Real Seal SE (n=15)	2.63±2.09	0.76- 7.17	1.26±0.36	0.84 - 2.04

Table 1. Push-out bond strength (MPa) of the tested sealers; Adseal, AH Plus, RealSeal SE

		≤30 years			≥60 years		
		Ad seal	AH Plus	Real Seal SE	Ad seal	AH Plus	Real Seal SE
≤30 years	Ad seal		0.995	0.094	1.000		
	AH Plus			0.024		0.998	
	Real Seal SE						0.026
≥60 years	Ad seal					1.000	1.000
	AH Plus						0.998

*p value = 0.029 (Two-Way ANOVA)

Table 2. Multiple comparison of mean push-out bond strength of tested sealers
Bold typed indicates statistically significant at p≤0.05 (Tukey test)

The results of Post-hoc multiple comparison are shown in Table 2.

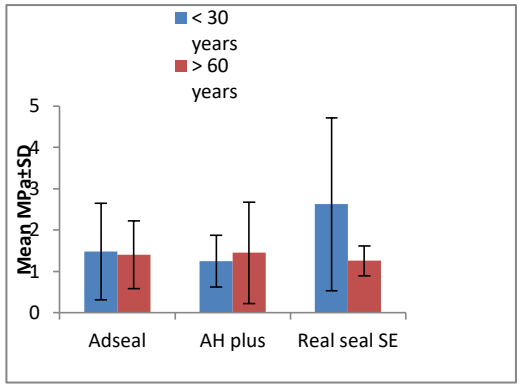


Figure 2. Push-out bond strength (MPa) of the tested sealers

According to this analysis, in the ≤30 years-age group, the push-out bond strength of RealSeal SE sealer was significantly higher than that of AH Plus sealer (p=0.024). In the ≥60 years-age group, there was no statistically significant difference in push-out bond strength between the sealers at all. However, the specimens of RealSeal SE sealer in ≤30 years-age group had a significantly higher bond strength than that in the ≥60 years-age group (p=0.026).

Failure modes of tested specimens of ≤30 years-age group and ≥60 years-age group were shown in Table 3. An example of adhesive failure of Adseal and AH Plus and an example of mixed failure of RealSeal SE were shown in Figure 3, Figure 4 and Figure 5.

Table 3. Failure modes of tested specimens of each age group

	Adseal		AH Plus		RealSeal SE	
	≤30	≥60	≤30	≥60	≤30	≥60
Adhesive Failure (gp-sealer)	100	86.3	100	74.1	11.8	47.8
Cohesive Failure	--	--	--	--	--	--
Mixed Failure	--	13.7	--	25.9	88.2	52.2

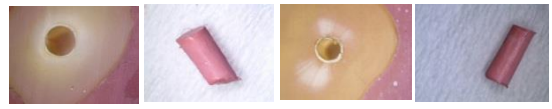


Figure 3. An example of adhesive failure of Adseal in ≤30 years, in ≥60 years

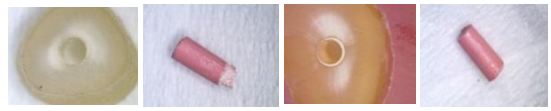


Figure 4. An example of adhesive failure of AH Plus in ≤30 years, in ≥60 years

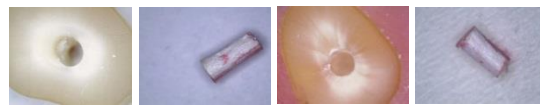


Figure 5. An example of adhesive failure of RealSeal SE in ≤30 years, in ≥60 years

Discussion

Bond strength evaluations have become popular to determine the effectiveness of the adhesion of dental materials to root canal dentin. Nevertheless, bond strength to intraradicular dentin is only one factor that must be considered when evaluating the quality of root canal sealing. In most cases, the results of laboratory experimental studies cannot be directly transposed to the clinical situation.

In this study, push-out bond strengths of three resin sealers were determined in two different age groups. The push-out bond strengths of epoxy resin sealers; Adseal and AH Plus were the more or less the same for both ≤30 years-age and ≥60 years-age groups. The bond strength of RealSeal SE in ≥60 years-age group was similar with that of Adseal and AH Plus, but the bond strength in ≤30 years-age group was significantly higher than all bond strengths obtained. Actually, RealSeal

SE contains the hydrophilic monomers hydroxy-ethyl methacrylate (HEMA) and 4-methacryloxyethyl trimellitate anhydride. The wet and wide dentinal tubules in young teeth may favor the penetration of the materials (Nakabayashi & Takarada, 1992; Van Landuyt *et al*., 2008; Nagas *et al*, 2012), and thus enhanced adhesive strength of RealSeal SE in ≤30 years-age group. Moreover, though the mild self-adhesive RealSeal SE may not be potent enough at a pH of 3.9 to effectively demineralize the dentin surface of older teeth (Gainnini *et al*., 2003; Kim *et al*., 2009b) this potency of pH may be potent enough for young teeth to enhance the bonding capacity.

In this study, specimens filled with RealSeal SE sealer, though which is a dual-cure system, were not irradiated immediately after filling from the coronal end to prevent fast setting of resin by light source which leads to restriction of flow and consequent defects or weakening of bond strength. Moreover, slow chemical reaction of methacrylate resin-based self-etching sealers may reduce shrinkage stress by means of prolonged plastic flow during polymerization (Radovic *et al*., 2008). Such behavior would allow for complete resin infiltration into the demineralized dentin.

During the specimen preparations, canals were not thoroughly dried but kept moist to prevent reduction in resin penetration and achieve higher bond strength for self-etching sealers (Kim *et al*., 2009a). Leaving slightly moist canals before obturation could be advantageous for self-etching resin sealers (Zmener *et al*., 2008; Nagas *et al*., 2012).

The analysis of failure modes of present findings was in accordance with Babb *et al*. (2009). In their study, the failure modes correlated well with the results of the push-out tests. As the resistance to dislocation increases, disruption of sealer-dentin interface becomes less likely and failure is more likely to occur within the sealer itself. In their study, the RealSeal SE which had mixed failure and higher push-out bond strength than other sealers tested. Similar results were found in this study, in which the mixed failure was 88.2% and adhesive failure between sealer and core material was only 11.8% in RealSeal SE in younger age group. On the other hand, the adhesive failure between the sealer and core filling material was 100% in Adseal and AH Plus. This finding implies that dentin surface of canal wall was covered with sealers, and detached gutta-percha was devoid of sealers in Adseal and AH Plus sealers, whereas there may be some links between ReaSeal SE and gutta percha.

Although the values of the present push-out test were very low, they were consistent with results of other studies using the same methodology, indicating that the bonding of methacrylate resin-based sealers and root dentin is much weaker than with resin-dentin bonds, 25-30 MPa (Tay & Pashley, 2007). This may be due to the difficulties in testing materials with great plasticity, like gutta-percha, Resilon and EndoREZ points; in contrast, when the test was done with sealer only and no core material, values were higher (Babb *et al*., 2009; Barbizam *et al*., 2011). Therefore, further studies are still necessary to clarify the effectiveness of self-adhesive methacrylate resin-based sealers in root canal obturation though these materials are later products.

Conclusion

To the limitation of this investigation, although push-out bond strength of methacrylate resin based sealer, RealSeal SE showed the highest bond strength in younger-age group, all tested sealers either epoxy resin-based or methacrylate resin-based manifested some degree of push-out bond strength values in both age groups. Therefore, it can be assumed that structural difference of dentin has no impact on interfacial bond strength either in negative or positive effects. This ability will predictably contribute to the success of endodontic treatments for all patients.

COI

The authors declare there is no potential conflict of interest.

References

[1] Babb, B.R., Loushine, R.J., Bryan, T.E., Ames, J.M., Causey, M.S. & Kim, J. (2009). Bonding of self-adhesive (self-etching) root canal sealers to radicular dentin. *Journal of Endodontics*, 35, pp. 578-582.

[2] Barbizam, J.V.B., Trope, M., Tanomaru-Filho, M., Teixeria, E.C.N. & Teixeria, F.B. (2011). Bond strength of different endodontic sealers to dentin: push-out test. *Journal of Applied Oral Science*, 19(6), pp. 644-647.

[3] Cobankara, F.K., Adnir, N., Belli, S. & Pashley, D.H. (2002). A quantitative evaluation of apical leakage of four root-canal sealers. *International Endodontic Journal*, 35, pp. 979-984.

[4] Epley, S.R., Fleishman, J., Hartwell, G. & Cicalese, C. (2006). Completeness of root canal obturations: Epiphany techniques verses gutta-percha techniques. *Journal of Endodontics*, 32, pp. 541-544.

[5] Giannini, M., Chaves, P. & de Oliveira, M.T. (2003). Effect of tooth age on bond strength to dentin. *Journal of Applied Oral Science***,** 11(4), pp. 342-347.

[6] Hiraishi, N., Papacchini, F. & Loushine, R.J. (2005). Shear bond strength of Resilon to a methacrylate-based root canal sealer. *International Endodontic Journal*, 38, pp. 753-763.

[7] Kardon, B.P., Kuttler. S., Hardigan P. & Samuel O. (2003). An *in vitro* evaluation of the sealing ability of a new root-canal-obturation system. *Journal of Endodontics*, 29, pp. 658-661.

[8] Kim, Y.K., Grandini, S., Ames, J.M., Gu, L., Kim, S.K., Pashley, D. H., Gutman, J.L & Tay, F.R. (2009a). Critical review on methacrylate resin based root canal sealers. *Journal of Endodontics*, 35, pp. 1-17.

[9] Kim, Y.K., Mai, S. & Haycock, J.R. (2009b). The self-etching potential of Realseal vs RealSeal SE. *Journal of Endodontics*, 35, pp. 1264-1269.

[10] Kinney, J.H., Nallab, R.K., Pople, J.A., Breunigd, T.M. & Ritchie, R.O. (2005). Age-related transparent root dentin: mineral concentration, crystallite size, and mechanical properties. *Biomaterials*, 26, pp. 3363-3376.

[11] Nakabayashi, N. & Takarada, K. (1992). Effect of HEMA on bonding to dentin. *Dental Materials*, 8, pp. 125-130.

[12] Nagas, E., Cehreli, Z.C., Durmaz, V., Vallittu, P.K. & Lassila, L.V. (2007). Regional push-out bond strength and coronal microleakage of Resilon after different light-curing methods. *Journal of Endodontics*, 33, pp. 1464-1468.

[13] Nagas, E., Uyanik, M.O., Eymirli, A., Cehreli, Z.C., Vallittu, P.K., Lassila, L.V.J. & Durmaz, V. (2012). Dentin moisture conditions affect the adhesion of root canal sealers. *Journal of Endodontics*. 38, pp. 240-244.

[14] Radovic, I., Monticelli, F., goracci, C., Vulicevic, Z.R. & Ferrari, M. (2008). Self-adhesive resin cements: A literature review. *Journal of Adhesive Dentistry*, 10(4), pp. 251-260.

[15] Schwartz, R.S. (2006). Adhesive dentistry and endodontics part 2: Bonding in the root canal system-the promise and the problem: A review. *Journal of Endodontics*, 32, pp. 1125-1134.

[16] Silva-Neto, U.X., Moraes, I.G., Westphalen, V.P.D., Menzes, R., Carneiro, E. & Fariniuk, L.F. (2007). Leakage of 4 resin-based root canal sealers used with single-cone technique. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology*, 104, pp. e53-e57.

[17] Skidmore, L., Berzins, D. & Bahcall, J. (2006). An *in vitro* comparison of the intraradicular dentin bond strength of resilon and gutta-percha. *Journal of Endodontics*, 32, pp. 963-966.

[18] Sly, M.M., Moore, B.K., Platt, J.A. & Brown, C.E. (2007). Push-out bond strength of a new endodontic obturation system (Resilon/Epiphany). *Journal of Endodontics*, 33, pp. 160-162.

[19] Tay, F.R. & Pashley, D.H. (2007). Monoblocks in root canals: a hypothetical or a tangible goal. *Journal of Endodontics*, 33, pp. 391-398.

[20] Teixeira, C.S., Correˆa Silva-Sousa, Y.T. & Sousa-Neto, M.D. (2009). Bond strength of fiber posts to weakened roots after resin restoration with different light-curing times. *Journal of Endodontics*, 35, pp. 1034-1039.

[21] Tronstad, L. (1991). *Clinical Endodontics.* 2nd Revised Edition. Thieme Medical Publishers, New York.

[22] Van Landuyt, K.L, Snauwaert, J. & Peumans, M. (2008). The role of HEMA in one-step self-etch adhesives. *Dental Materials*, 24, pp. 1412-1419.

[23] Zmener, O., Pameijer, C.H., Serrano, S.A., Vidueira, M. & Macchi, R.L. (2008). Significance of moist root canal dentin with the use of methacrylate-based endodontic sealers: an *in vitro* coronal dye leakage study. *Journal of Endodontics*, 34, pp. 76-79.

Effectiveness of Impression Making with or without Border Molding for Unfavourable Edentulous Mandible

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Abstract **- Border molding is an important procedure in complete denture construction since it promotes the development of border seal. It is necessary for maintaining denture border with the adjacent vestibular tissues during rest as well as functional activity. However, border molding is a time consuming procedure especially for elderly patients. This study aimed to compare the effectiveness of impression making with or without border molding in terms of retention, stability, and masticatory efficiency. The study consists of fifteen unfavourable mandibular edentulous patients. Two customized close-fitting acrylic trays, one with full extensions to the periphery and another one with 2 mm short from the borders, were made on the cast obtained from the preliminary impression. Border molding procedure was performed in segment by segment using thermoplastic impression compound along the tray which was short from borders. On both trays, final impression was made with zinc oxide eugenol impression paste and complete dentures were fabricated. Each patient received two mandibular complete dentures fabricated from impression making with and without border molding. The retention and stability for both types of dentures were measured quantitatively at the time of denture delivery. Two weeks after denture delivery, masticatory efficiency was evaluated by color-changeable chewing gum. Although there was no significant difference in retention of two mandibular complete dentures (*p* value >0.05) there was statistically significant in stability of mandibular complete dentures (*p* value <0.05). Mean retention of dentures fabricated from impression making with and without border molding are 615.33 gf (±276.51) and 512.67 gf (±228.89) respectively. Mean stability of dentures fabricated from impression making with and without border molding are 764 gf (±169.78) and 499.33 gf (±138.59) respectively. The two mandibular dentures were not statistically significant difference in terms of masticatory efficiency (60.2% versus 59.8%). It was concluded that impression making without border molding procedure could be useful alternative to conventional border molding and can be accomplished using correctly trimmed custom impression tray.**

Keywords**;** ***border molding, unfavourable edentulous mandible, retention, stability, masticatory efficiency***

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Introduction

Nowadays, patients with severe residual alveolar ridge resorption are relatively common in both private dental sectors and teaching hospitals. The unfavourable mandibular ridge is more challenging to make impression than the maxillary ridge. Capturing the denture-bearing area is crucial in providing the patient with a functional prosthesis and making a good and accurate impression plays an important role in providing adequate retention, stability and comfort to the complete denture patient.

According to Mack (1978), impression material and technique depend on three factors such as (1) surface detail (2) compression or non-compression of denture bearing mucosa (3) the most effective means of representing the functional periphery. In addition, the peripheral sealing zone is an important region for denture retention and stability and should be correctly contoured during the final impression procedure.

As described by Jayaprakash *et al*. (2014), the effectiveness of a complete denture mainly depends on basic principles of impression making such as maximum coverage of supporting area, peripheral seal without interference with functional movements and accurate adaptation to the tissues for interfacial seal. To ensure maximum support, retention and stability for the denture during use, the entire functional denture bearing area must be recorded. However, it is difficult to perform full functional recording when the condition of the denture bearing areas is not suitable.

Because of the anatomical differences between maxilla and mandible, and differences in primary and secondary supporting areas, impression making for the unfavourable mandibular ridges needs particular considerations. Making a definitive impression of an edentulous arch may be difficult when there is minimal bone height, unfavourable residual ridge morphology, and unfavourable muscle attachment (McGarry *et al.*, 1999). The lack of peripheral seal and hence loss of retention is more severe with extremely resorbed ridges.

The suitable impression tray is the foundation of an accurate impression. The careful design of custom trays enhances their clinical effectiveness and thus help the clinician achieve the desired goal. Despite the frequent use of custom trays, few clinicians appear to specify the design details to be used in their construction (Smith *et al*., 1999). Improving the custom trays should lead not only to more efficient use of chair-side time but also to an improved quality of definitive impressions, and hence the final prostheses.

To promote the development of border seal which is necessary to maintain contact of denture border with adjacent vestibular tissues during resting or functional activities, it is necessary to perform the border molding procedure (Gupta *et al*., 2015). Border seal is defined as the contact of denture border with the underlying or adjacent tissues to prevent the passage of air or other substances (Glossary of Prosthodontic Terms, 2005).

The significant point of border molding procedure is to duplicate contour and size of the vestibule by functional or manual manipulation of the tissue adjacent to the borders. If the denture borders are terminated on soft resilient tissues, it will allow the mucosa to move with the denture base and thereby maintaining peripheral seal (Yarapatineni *et al*., 2013). Thus,

development of an accurate custom tray design and use of an effective material and border molding technique are important (Malachias, *et al*., 2005).

Various methods and impression materials have been tried for accurate shaping of the denture periphery in accordance with the morphological and functional conditions of an edentulous mouth. Recently, as an alternative to the conventional method where borders were molded with modelling compound, Appelbaum and Mehra (1984) recommended polyvinyl siloxane putty and light body impression material for the final impression.

Modelling compound sticks have many advantages such as these materials can be softened easily and are harden at oral and room temperature. Modelling compound sticks require relatively high working temperatures, so great care must be taken not to harm or irritate the patient.

The fear of harming the patient and delay in seating the tray may lower the temperature of the material and will often result in overextended borders (Levin, 1984). The working time is limited, so skill is required to obtain good borders. Modelling compound is usually applied in small sections, although larger sections are possible if the operator is skillful. Smith *et al*. (1979) used polyether in a single step impression procedure. Moreover, tissue treatment materials and impression waxes were advocated by Klein and Broner (1985).

Nevertheless, border molding is a time consuming procedure especially for elderly patients. Older people require special considerations. Biological decline and health problems may adversely influence some intellectual functions. For example, the elderly performs psychomotor response less efficiently. Treatment plans should, wherever possible, be simple and simply explained (Barnes *et al.*, 1994). Therefore, the reduced clinical chair-side time is a convenient option for clinicians to provide a more comfortable treatment for geriatric patients.

Given these challenges, a simple and fast technique for impression making in elderly patients is greatly needed. The final impression can be performed within the fewest possible clinical time without compromising the quality of prosthesis such as correct periphery extension, close adaptation, proper occlusion and satisfactory aesthetics. Fewer chair-side time are more tolerable for the patient and also minimize the inconveniency.

In this study, the effectiveness of the resultant dentures fabricated by impression making with or without border molding was compared. This study expects a simple, quick and reliable technique to make impression of the unfavourable mandibular ridge using a close-fitting custom tray with correctly trimming periphery and zinc oxide eugenol wash impression material that helps in recording fine details of the ridge, promoting interfacial seal.

Material and Methods

Fifteen lower completely edentulous patients attending the Department of Prosthodontics, University of Dental Medicine, Yangon were collected according to inclusion criteria. Inclusion criteria are: patients who willingly agree to participate in the study and give informed consent, age of 60 years and above, patients with skeletal I jaw relationship, patients with unfavourable mandibular ridge according to Atwood's order V or VI, patients who are available for follow up. Patients with exostosis,

patients with temporomandibular joint symptoms and patients who have undercuts in the denture bearing area were excluded in this study.

Each patient received two sets of mandibular complete dentures fabricated using impression trays with or without border molding so that thirty samples were obtained. Impression making was done with irreversible hydrocolloid impression material by using a suitable size perforated edentulous stock tray and poured in dental stone to obtain the primary cast.

Two customized close-fitting acrylic trays were constructed on primary casts as follows: markings for the acrylic tray to be border molded were at 2 mm short of estimated tissue reflection line of the primary cast. Another close-fitting acrylic tray was extended to the estimated tissue reflection line of primary cast on which border molding would not be carried out. The close-fitting tray of about 2-3 mm thickness was made over the primary cast by sprinkle method using an autopolymerizing acrylic resin.

Before the commencement of border molding, the periphery of the tray was checked in the mouth for extensions approximately at 2mm short of the vestibular reflections and any overextension of the tray was identified and all necessary adjustments was executed. After completing the border molding procedure, the final wash impression was made by using zinc oxide eugenol impression paste.

The tray with full extensions was checked by cheek retraction and the border of the tray was carefully trimmed to fully extend the correct peripheral contour bearing in mind that the important load bearing areas were covered or not. The tray was adjusted in the patient's mouth till it did not dislodge during various muscle movements and final impression was made with zinc oxide eugenol impression paste. The two dentures were fabricated for each technique in a patient.

At the time of denture delivery, the retention and stability for both types of dentures were measured by Handy Analog Push-Pull Gauge. Masticatory efficiency was assessed after two weeks of denture delivery. In this study, color-changeable chewing gum was used for evaluation of masticatory efficiency. Then the two mandibular complete dentures were crossed over and masticatory efficiency of the second delivered denture was assessed after two weeks of denture delivery**.**

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon (ERC/UDMY /2019/027). Informed consents were obtained from all subjects participating in the study after thorough explanation of the study procedures.

Figure 1. Border molding with thermoplastic green stick compound

Figure 2. Close-fitting acrylic tray with full extension after adjustment

Figure 3. Zinc oxide eugenol final impression after border molding

Figure 4. Final impression making without border molding

Statistical Analysis

Data entry and analysis was done by using Statistical Package for Social Sciences (SPSS) software (version 16). Data were described as mean and standard deviation for continuous variables of normally distributed data. To compare the continuous variables between two methods, paired t test was applied. The level of significance was set at 0.05.

Results

Table 1. Comparison of retention of mandibular complete dentures fabricated by impression making with and without border molding (n=15)

	With border molding (n=15)		Without border molding (n=15)		*p*-value (paired t test)
	Mean	SD	Mean	SD	
Reten -tion (gf)	615.33	±276.51	512.67	± 228.89	0.091

gf (gram force)

Data are presented as mean and standard deviation (SD).

Mean retention of mandibular complete dentures fabricated by impression making with and without border molding were 615.33 gf (±276.51) and 512.67 gf (±228.89) respectively. The *p* value is >0.05, and thus there is no significant difference in retention between the two dentures at denture delivery stage.

Table 2. Comparison of stability of mandibular complete dentures fabricated by impression making with and without border molding

	With border molding (n=15)		Without border molding (n=15)		*p*-value (paired t test)
	Mean	SD	Mean	SD	
Stability (gf)	764	±169.78	499.33	±138.59	0.000

Data are presented as mean and standard deviation (SD).

Mean stability of mandibular complete dentures fabricated by impression making with and without border molding were 764 gf (±169.78) and 499.33 gf (±138.59) respectively. The *p* value is <0.05, and thus there is statistically significant difference in stability between the two dentures at denture delivery stage.

Table 3. Comparison of masticatory efficiency of two different mandibular complete dentures

	With border molding (n=15)		Without border molding (n=15)		*p*-value (paired t test)
	Mean	SD	Mean	SD	
Masticatory efficiency level (%)	60.2	±12.6	59.8	±12.0	0.820

Data are presented as mean and standard deviation (SD).

Mean masticatory efficiency level (%) of mandibular complete dentures fabricated by impression making with and without border molding were 60.2 (±12.6) and 59.8 (±12.0) respectively. The *p* value is >0.05, and thus masticatory efficiency level of two different mandibular complete dentures is not statistically significant different.

Discussion

Border molding procedure requires multiple placement of tray in the patient mouth. The procedure is usually divided into various steps where sections of tray borders are molded in multiple applications and thereby establishing peripheral seal as a continuation of border molding.

The results of this study proved that there was no statistically significant difference in retention, and masticatory efficiency between mandibular complete dentures fabricated from impression making with and without border molding. According to the outcomes of the study, it can be regarded as the effectiveness of both types of dentures is similar to one another whether border molding procedure was performed or not.

Kaur *et al.* (2016) conducted a study on importance of border molding and proved that the dentures made with border molding will provide better retentive force than the dentures made without border molding. However, this finding was contrary to the results of Rady and Naby (2017) who reported in their study that no statistically significant difference was detected between the three different final impression techniques (sectional border molding with low fusing compound, sectional border tracing with putty elastomeric impression material and third impression with special tray without border molding).

The results obtained from the present study showed that there was no significant mean difference between retentive forces of dentures fabricated with and without border molding (*p* value >0.05). According to results, the retention of mandibular complete denture fabricated from impression making without border molding was reasonably good in all patients.

Wright (2004) stated that with increase in retention of the denture, the denture stability will also increase. Some degree of retention must be present for mandibular dentures to have the quality of stability. There has been few reports on relation between stability of complete dentures and final impression making with or without border molding procedure. In the present

study, it was found that although the retention between the two dentures was not different, there was greater in stability of denture fabricated by impression making with border molding than denture fabricated by impression making without border molding.

The masticatory performance was similar for both groups, regardless of border molding procedure providing clinical significance of an impression making which eliminates border molding procedure can provide complete dentures of good clinical quality. Evaluation of the data found that the masticatory efficiency of patients wearing complete dentures fabricated from impression making without border molding was not different from those wearing dentures made with border molding which agrees with the findings of the study conducted by Cunha *et al*. (2013). Their study found similar masticatory performance and ability between individuals rehabilitated with complete dentures fabricated by a simplified protocol and conventional protocol.

In the present study, primary impression was made with irreversible hydrocolloid material using perforated stock tray. It is a mucostatic impression material and no real compression of the peripheral tissues occurs and over-extension is unlikely. Moreover, it can produce desired amount of tissue displacement by elastic distension without causing traumatic extension of the vestibules. It is therefore extremely important that the preliminary impression should be made carefully and meticulously to develop an accurate and stable tray.

The development of an abbreviated technique for complete denture construction that eliminates the use of a border-molded custom tray is certain to elicit concern from those who value more traditional techniques (Duncan & Taylor, 2001). In this study, they concluded that one step irreversible hydrocolloid impression in a stock tray, in place of the traditional final impression in a border-molded custom tray, significantly decreased the number of visits required to fabricate complete dentures in a student clinic. These findings support the validity of the simple technique.

The frequent problems faced with border molding procedure are overextended thick borders and prolonged chair-side time. Duncan and Taylor (2001) stated that despite much effort at the border molding and final impression stage, many dentures were found to be overextended at the time of delivery.

The present study showed a simple, quick and reliable procedure for final impression making of the unfavourable mandibular ridge using a correctly trimmed custom tray which is adequately supported for zinc oxide eugenol impression material. With the periphery of custom tray correctly trimmed, it is possible to make final impression in one insertion without border molding procedure. This can eliminate the drawback of time consuming border molding procedure and is especially advantageous to elderly patients.

Conclusion

Impression making without border molding procedure could be advantageous alternative to conventional border molding and can be accomplished using correctly trimmed custom impression tray. The choice of a particular technique should be based on clinical indications, operator skill, and convenience of both operator and patient.

COI

The authors declare there is no potential source of interest.

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References

[1] Appelbaum, E.M. & Mehra, R.V. (1984). Clinical evaluation of polyvinyl siloxane for complete denture impressions. *The Journal of Prosthetic Dentistry*, 52(4), pp. 537-539.

[2] Barnes, I., Seymour, R., Smith, D. & Walls, A. (1994). Management of the old patient. In Barnes, I. & Walls, A. (Eds.) *Gerodontology*. Wright, UK. pp. 51-54.

[3] Cunha, T.R., Vecchia, M.P.D., Regis, R.R., Ribeiro, A.B., Muglia, V.A., Mestriner, Jr. W. & de Souza, R.F. (2013). A randomised trial on simplified and conventional methods for complete denture fabrication: Masticatory performance and ability. *Journal of Dentistry*, 41, pp. 133-142.

[4] Duncan, J.P. & Taylor, T.D (2001). Teaching an abbreviated impression technique for complete dentures in an undergraduate dental curriculum. *The Journal of Prosthetic Dentistry*, 85(2), pp. 121-125.

[5] Glossary of Prosthodontic Terms (2005). *The Journal of Prosthetic Dentistry*, 94(1), pp. 10-92.

[6] Gupta, R., Luthra, R.P. & Mehta, S. (2015). Comparative analysis of two border molding techniques and materials on maxillary complete denture retention: An *in vivo* study. *International Journal of Clinical Cases and Investigations*, 4(2), pp. 85-90.

[7] Jayaprakash, M.B., Sahu, K., Khan, M., Khoriya, S. & Jadhav, S. (2014). Management of flabby ridge cases: A Challenge in Clinical Practice. *International Journal of Advanced Health Sciences*, 1(5), pp. 32-37.

[8] Kaur, S., Datta, K., Gupta, S.K. & Suman, N. (2016). Comparative analysis of the retention of maxillary denture base with and without border molding using zinc oxide eugenol impression paste. *Indian Journal of Dentistry*, 7(1), pp. 1-5.

[9] Klein, I.E. & Broner, A.S. (1985). Complete denture secondary impressiontechnique to minimize distortion of ridge and border tissues. *The Journal of Prosthetic Dentistry*, 54, pp. 660-664.

[10] Levin, B. (1984). *Impressions for Complete Dentures*. 1st Edition. Quintessence Publishing Co., Inc, Chicago.

[11] Mack, A. (1978). *Full Dentures: the Treatment of the Edentulous Patient*. Briston-John Wright & Sons Limited, London.

[12] Malachias, A., Paranhos, H.F.O., Silva, C.H.L., Mogolia, V.A. & Moreto, C. (2005). Modified functional impression technique for complete dentures. *Brazil Dental Journal*, 16(2), pp. 135-139.

[13] McGarry, T.J., Nimmo, A., Skiba, J.F., Ahlstrom, R.H., Smith, C.R. & Koumjian, J.H. (1999). Classification system for complete edentulism. The American College of Prosthodontics. *Journal of Prosthodontics*, 8(1), pp. 27-39.

[14] Rady, A.A. & Naby, N.E. (2017). The influence of border molding on retention and time of complete denture retention. *Egyptian Dental Journal*, 63(3), pp. 2863-2869.

[15] Smith, D.E., Toolson, L.B., Bolender, C.L., & Lord, L.J. (1979). One-step border molding of complete denture impressions using a polyether impression material. *The Journal of Prosthetic Dentistry*, 41(3), pp.347-351.

[16] Smith, P.W., Richmond, R. & McCord, J.F. (1999). The design and use of special trays in prosthodontics;

guidelines to improve clinical effectiveness. *British Dental Journal*, 187(8), pp. 423-426.

[17] Wright, C.R. (2004). Evaluation of the factors necessary to develop stability in mandibular dentures. *The Journal of Prosthetic Dentistry*, 92(6), pp. 509-518.

[18] Yarapatineni, R., Vilekar, A., Kumar, J.P., Kumar, G.A., Aravind, P. & Kumar, P.A. (2013). Comparative evaluation of border molding, using two different techniques in maxillary edentulous arches - An *in vivo* study. *Journal of International Oral Health*, 5(6), pp. 82-87.

Effectiveness of Cone-Beam Computed Tomography in Impacted Mandibular Third Molar Removal

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Abstract **- Neurosensory disturbance is the most serious complication following surgical removal of impacted mandibular third molar. Despite low complication rate, third molar removal is common that the population morbidity may be significant. Greater knowledge of the location and configuration of various mandibular anatomical landmarks can assist the safe performance of mandibular third molar removal procedures. A radiological examination of mandibular third molars is supposed to help the surgeon in establishing a treatment plan. With the assistance of advanced imaging techniques such as Cone-Beam Computed Tomography (CBCT), accurate location of anatomic structures has become a reality. The purpose of this study was to determine the effectiveness of CBCT in prediction of topographic relationship between the mandibular canal and impacted mandibular third molar. This was a clinical study of patients who underwent CBCT scanning of mandibular third molars when panoramic radiographs indicated an increased risk of inferior alveolar nerve injury during extraction. A total of 43 mandibular third molars were evaluated and the teeth were classified according to the presence or absence of contact between the tooth root and mandibular canal in CBCT finding. This was then related with intraoperative nerve exposure. Of the 43 cases, 16 cases (37.2%) revealed contact relationship in CBCT. Among them, 13 cases (30.2%) presented inferior alveolar nerve exposure. The radiological examination in relation to the frequency of nerve exposure yielded values of 100% for sensitivity and 90% for specificity. The positive and negative predictive values were 81.3% and 100% respectively. The rate of accuracy of CBCT was 93%. Therefore, CBCT is an effective and adjunct diagnostic aid to predict the proximity of IAN to impacted mandibular third molar.**

Keywords; CBCT, Inferior alveolar nerve exposure, Mandibular third molar

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Introduction

The mandibular third molars are the most frequently impacted teeth especially due to lack of adequate space caused by late formation or barriers in their eruption trajectory and the phylogeny of the mandible. These impacted teeth commonly bring about various sorts of pathological conditions including reiterative pericoronitis, odontogenic cysts or tumors, swelling, bone loss and root resorption of adjacent teeth, thus

unavoidably leading to impaired oral functions and discomfort (Wang *et al.*, 2016).

Impacted mandibular third molar is the main reason of permanent inferior alveolar nerve (IAN) injury, outweighing both implants and orthognathic surgery as etiological factors (Hillerup, 2008). Anatomy of the mandible itself provokes the risk for temporary or permanent neurosensory disturbances. The knowledge of the accurate location of the inferior alveolar neurovascular bundle is a very important factor since this information offers knowledge about regions where safe and quick removal of bone should be probable and danger zones where special care must be taken (Eyrich *et al.*, 2011).

The majority of injuries result in transient sensory disturbance but, in some cases, permanent paresthesia, hypoesthesia or even worse, some form of dysesthesia can arise (Loescher *et al*., 2003). Anesthesia or paresthesia of the lower lip can significantly change patients' quality of life. Missing or reduced sensory innervation of the lower lip causes difficulties during speech, eating and drinking and uncontrolled bite trauma of the soft tissues is more frequent.

The incidence of these neurological complications ranges from 0.2 to 1% for permanent injury and from 3.3 to 13% for temporary injury. The incidence rises to 30% when close relationship between third molars and mandibular canal is detected radiographically (Dalili *et al.*, 2011). Neurological complications arising from this sort of surgery may result from insufficient diagnosis of the neighbouring anatomical structures or the applied surgical procedure.

Therefore, an imaging assessment is undoubtedly a critical tool for diagnosis and surgical management since it provides valuable information about the morphology of the tooth concerning the degree of root formation, the number of roots and the presence of apical anomalies. It should provide the characteristics of the neighbouring bone and relationship with nearby anatomical structures (Pippi *et al.*, 2016). Recognizing these factors can help to select the adequate surgical technique and lessen the surgical complications mostly post-operative sensory impairment.

Orthopantomogram (OPG) is the most practical basic imaging technique in oral and maxillofacial surgery allowing the two-dimensional viewing of oral hard tissues. OPG can include the maxilla, mandible, teeth, temporomandibular joint and maxillary sinuses in a single image. However, owing to the tomographic nature of the technique, only structures situated within the tomographic plane are well described and those in front or behind the plane are indistinct (White & Pharoah, 2004). It offers limited information about the buccolingual relationship between the mandibular canal and third molars, the detailed anatomy of the third molars and cortication of mandibular canal.

Radiographic findings such as the darkening of the roots, interruption of the mandibular canal, diversion of the canal and narrowing of the roots are associated with neurosensory disturbances or with a close relationship between the lower third molar and the mandibular canal. If these signs are observed in OPG, Cone-Beam Computed Tomography (CBCT) is essential to properly assess this close relationship three dimensionally (Nakamori *et al.*, 2008).

CBCT devices were introduced in dentomaxillofacial imaging in the late

1990s. During X-ray exposure, a series of planar projection images of the field of view (FOV) are produced. Once the basic projection images have been developed, CBCT unit reconstructs the primary projection frames to deliver standard viewing displays of coronal, sagittal and axial images (Pauwels *et al*., 2015). Hence, the clinicians can enable to visualize the dental and maxillofacial structures more precisely and obviously from both several planes and three dimensional (3D) views.

CBCT offers numerous advantages together with lack of superimposition, the absence of geometric distortions, 1:1 measurements and 3D display. It has high spatial resolution in addition to multiplanar images free of overlapping as compared to other dental radiography. It delivers better image quality of teeth and their surrounding structures. Therefore, accurate assessment of the relationship of the third molars to the mandibular canal can be done with CBCT imaging modality. 2D radiographs provide information that can be beneficial for surgical planning, however only CBCT examination permit the reflection of the real situation of the tooth. Once the surgeon is aware of the close relationships, a better treatment plan may be designed.

IAN injury constitute one of the most frequent causes of complaints and litigation. It is therefore imperative that patients with increased possibility of nerve injuries are managed correctly and this includes correct diagnosis of position of nerve. Additional information provided by CBCT images influences the surgical strategy in the treatment of patients with impacted mandibular third molars in high risk cases. Besides, accurate preoperative prediction of neurovascular bundle exposure is extremely useful for warning patients of the potential risk of postoperative dysesthesia and obtaining informed consent. The purpose of this study is to determine the accuracy of the CBCT in the prediction of topographic relationship between the impacted mandibular third molar and mandibular canal as well as exposure of IAN during surgical procedures.

Materials and Methods

This study is a cross-sectional descriptive study. A total of 43 subjects with complaint of impacted mandibular third molars at Department of Oral and Maxillofacial Surgery were selected based on the inclusion criteria. Both genders with age group between 18-40 years, subjects with ASA I and II and patients with one or both impacted mandibular third molars that are closely related to IAN diagnosed by OPG were included in this study.

Exclusion criteria were pregnant and lactating women, impacted mandibular third molars that are associated with pathological lesions and trauma, any cases already existing neurosensory disturbances in the innervation area of trigeminal nerve and the case with adjacent second molars which are impacted simultaneously.

Firstly, any close relationship of the tooth root with mandibular canal was checked with OPG view by using Orthopantomograph® OP300. Features of close relationship are (a) interruption of the mandibular canal wall, (b) darkening of the root, (c) diversion of the canal and (d) narrowing of the root. The patient was explained about the risk of nerve injury during surgical removal and CBCT was suggested for further examination.

CBCT was taken to evaluate the topographic relationship between the impacted tooth and mandibular canal. As CBCT apparatus, Orthopantomograph® OP300 developed by Kavo Kerr was used and Field of View (FOV) was 8x15. Data was reconstructed using Cliniview® software and OnDemand® 3D Dental viewing software.

After scanning, contiguous sectional images in 3 sections, i.e. parallel section (parallel to the dental arch), cross section (perpendicular to the dental arch) and horizontal section images were reconstructed. The presence or absence of contact between the tooth root and canal was evaluated by two dental surgeons who are well trained in CBCT. Loss of bone tissue between the two structures observed on all 3 sections was considered as direct contact between the tooth and canal. These radiographic features were related with the intraoperative findings, that is, the presence or absence of IAN exposure at the time of extraction.

Routine standard operative procedures were performed under aspetic condition. After removal of tooth and thorough irrigation with normal saline, exposure of IAN was carefully examined under direct vision using head light. Bleeding was controlled and primary closure was done. The intraoperative finding was then recorded. The dysesthesia of the chin and lip was assessed on postoperative 7th day. For the light touch test, a cotton wisp was used to test tactile stimulation by gently touching the skin and the detection threshold of the patient was evaluated.

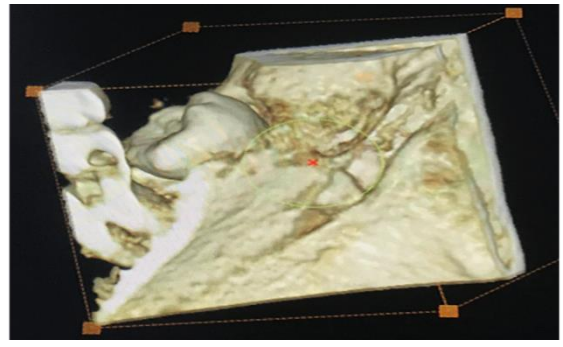

Figure 1. Cross section showing contact relation of impacted tooth with mandibular canal on CBCT

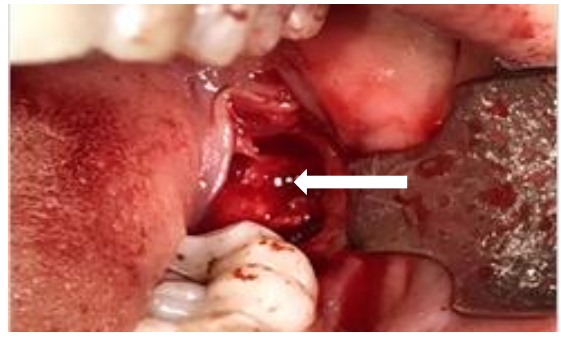

Figure 2. Extracted socket of impacted third molar with IAN exposure

Figure 3. Extracted socket of impacted third molar without IAN exposure

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon. The cases were selected only after thorough

explanation and a written informed consent had been obtained.

Statistical Analysis

Data entry and data analysis were carried out by Statistical Package for Social Science (SPSS) software (version 16.0). Descriptive and summary statistics were carried out. The diagnostic accuracy of the Cone-Beam Computed Tomography was assessed using sensitivity, specificity, positive predictive value, negative predictive value and accuracy of the test.

- Sensitivity = TP /TP+FN
- Specificity = TN/ TN+FP
- PPV= TP/TP+FP
- NPV=TN/TN+FN
- Accuracy of test = TP+TN/ GT

Results

This study consisted of 43 impacted third molars which were contact relationship with mandibular canal in conventional OPG assessment. The topographic relationship was evaluated three dimensionally by means of CBCT and then the interpretation was correlated with intraoperative inferior alveolar nerve exposure. Subjective sensory changes were evaluated 1 week after surgery to determine the nerve damage.

According to Pell and Gregory classification, 72% of cases were PG II and the latter PG I and III were 14% each. As for height of impaction, 30.2% were level A. Level B was the most common and C was the least, 62.8% and 7% respectively. Horizontal inclination was mostly included; 51.2% and distoangular type (4.7%) is the least in this study. 23.3% were mesioangular, and 20.8% were vertical inclination.

Three dimensional radiographic signs of nerve proximity in CBCT was shown in table 1. Out of 43 subjects, 16 subjects (37.2%) had contact relationship between the mandibular canal and impacted tooth while remaining 27 subjects (62.8%) had separate relationship. However, only 13 cases (30.2%) experienced nerve exposure during surgical procedure and was shown in Table 2. Postoperative dysesthesia of the subjects was revealed in Table 3.

Table 1. Radiographic signs in CBCT of the subjects

CBCT	Frequency	Percent
Separate	27	62.8
Contact	16	37.2
Total	43	100.0

Table 2. Exposure of inferior alveolar nerve of the subjects

Nerve exposure	Frequency	Percent
Absent	30	69.8
Present	13	30.2
Total	43	100.0

Table 3. Postoperative Dysethesia of the subjects

Dysesthesia	Frequency	Percent
Absent	40	93.0
Present	3	7.0
Total	43	100.0

Table 4. Accuracy of Cone-Beam Computed Tomography in topographic relationship between the mandibular canal and impacted mandibular third molar

CBCT	Nerve exposure in operation		Total
	Present	Absent	
Contact	13	3	Contact
Separate	0	27	Separate
Total	13	30	Total

Sensitivity=100% (95% CI=79.4%, 100%)
Specificity=90% (95% CI=75.1%, 97.4%)
PPV=81.3% (95% CI=0.570 %, 95%)
NPV=100% (95% CI=89.5%, 100%)
Accuracy=93% (95% CI=82.2%, 98.2%)

The 3 subjects (7%) complained of dysesthesia on 7th postoperative day. Accuracy of Cone-Beam Computed Tomography in prediction of topographic relationship between the mandibular canal and impacted mandibular third molar was shown in Table 4. CBCT revealed contact relationship between canal and impacted molar in 16 subjects. Among them, 13 subjects had intraoperative nerve exposure. The remaining 27 subjects had separate relationship between the canal and impacted molar in CBCT and none of them had nerve exposure in operation. Therefore, sensitivity of CBCT was 100% while specificity was 90%. The positive predictive value and negative predictive value were 81.3% and 100% respectively. Accuracy of CBCT was 93%.

Discussion

Impacted mandibular third molar is one of the most common findings that is observed in daily dental practice. Efforts to reduce intraoperative or postoperative complications may have a great impact in respect of enhancing patient outcome.

Impacted mandibular third molars are contiguous with the inferior alveolar, lingual, buccal and mylohyoid nerves. During surgical removal, each of these nerves is in danger of injury but the foremost troublesome complications arise from inferior alveolar and lingual nerve injuries (Meshram *et al.,* 2013). Mostly, this is because of inaccurate assessment of an operator from conventional radiographs.

Radiographic diagnosis prior impacted mandibular third molar extraction is vital to assess the depth of impaction and root condition along with its relation to mandibular canal to predict the risk of postsurgical extraction (Nasser *et al.*, 2018). In oral and maxillofacial surgery, panoramic radiography is a supplementary examination primarily requested to evaluate impacted third molars and estimate the risk of IAN damage. Nevertheless, this image modality has a distortion and does not always provide sufficient data to determine the actual risk level (Neves *et al.,* 2012). Recently, with the help of advanced imaging techniques such as CBCT, accurate position of anatomic structures has become a reality (Kavarthapu & Thamaraiselvan, 2018).

The root of the third molar was considered to be in contact with the neurovascular bundle in the mandibular canal if loss of the cortical lining of the mandibular canal was detected in all of the axial, coronal and sagittal sections of the CBCT. The incidence of root contact with the canal in CBCT was found in 37.2% of the third molars in this study. The remaining 62.8% were separate relationship between the canal and third

molar. This frequency of contact relationship is lower than those reported by Ghaeminia *et al.* (2009) (85%) but higher than that reported by Tantanapornkul *et al*. (2007) which was 28%. The differences detected in these studies may be due to the various case selection criteria used for CBCT examination.

As reported by Ghaeminia *et al.* (2011), the amount of cases related to the contact of the tooth and the IAN that were observed in CBCT were considerably less than those that were observed in panoramic radiographs. Also, Dalili *et al.* (2011) stated significant differences in the relationship between mandibular third molar and the mandibular canal as seen in the CBCT and OPG findings. These are in accordance with the present study where 27 in 43 teeth that had already revealed closed relationship with IAN in OPG were separate relationship in CBCT. This may be due to drawback of OPG which has image distortion and 2D display of surrounding structures with low sensitivity and specificity. Thus, further standardization of diagnostic criteria is needed over OPG for third molar removal.

The incidence of nerve exposure was observed in 13 subjects (30.2%) whereas only 3 subjects (7%) experienced postoperative dysesthesia. All cases of inferior alveolar paresthesia were transient and no prolonged altered sensations were observed after three months. The prevalence of IAN exposure during third molar surgery has been reported to be associated with an increase in IAN injury. This increases the likelihood of injury by approximately 20.0% to 36.8% (Nakamori *et al.,* 2008). However, the overall percentage of IAN exposure was 18% in cases with an increased risk of IAN injury in the study of Korkmaz *et al.* (2017) that is similar to the finding of present study.

Tay and Go in 2004 studied the prevalence of inferior alveolar nerve paresthesia in those patients with inferior alveolar nerve exposure during third molar surgery. It was concluded that such a condition hints an increased probability of intimate relationship of the nerve with the tooth and carries a 20% risk of paresthesia with a 70% chance of recovery by one year.

In all cases of intraoperative IAN exposure, the cortex was interrupted on CBCT images. All cases in which the cortical bone was continuous on CBCT images revealed no association with nerve exposure. CBCT was able to predict a direct contact between the third molar root and IAN with 93% accuracy (sensitivity 100%, specificity 90%, PPV 81.3%, NPV 100%). High sensitivity and high NPV also exclude that an IAN exposure is found in the case of continuous IAN cortical bone on CBCT images.

This frequency is comparable with that reported by Pippi *et al*. (2016). But, in that study, a very small area of exposure might have been overlooked and this might be partly attributed to the relatively low specificity of imaging. CBCT was capable of predicting direct contact between the third molar root and IAN with a 75.67% accuracy (sensitivity: 100%; specificity: 58.14%; PPV: 63.27%; NPV: 100%).

Tantanapornkul *et al.* (2007) conveyed that CBCT was notably superior to panoramic images for prediction of neurovascular bundle exposure during extraction of impacted mandibular third molars. The sensitivity and specificity were 93% and 77%. The diagnostic accuracy of CBCT in

predicting neurovascular bundle exposure was 80%.

The anatomical proximity of third molar roots to the neurovascular bundle increases the risk of an IAN injury. The present study showed a strong association between IAN injury and interruptions of canal wall on CBCT images. Actually, despite the fact that CBCT allowed to identify all cases of intraoperative nerve exposure, the IAN was not clinically observable in some cases in which the cortical bone interrupted on CBCT. Ghaeminia *et al.* (2009) found that IAN exposure is less likely when it runs lingually to the root or interradicularly. Therefore, interruption of IAN cortex on CBCT images does not always necessarily imply that the IAN is clinically visible. Conversely, the presence of a cortex which separates the IAN from the third molar root seems to totally exclude the likelihood of intraoperative nerve exposure.

Conclusion

Mandibular third molar surgery is a very frequently carried out procedure in daily dental practice and is undoubtedly associated with few risks especially neural injuries. Understanding of the relationship between mandibular third molars and the inferior alveolar canal is of paramount importance to diminish the incidence of nerve injury. The present study represents that CBCT provides reliable information about the location of inferior alveolar canal and its proximity to mandibular third molar.

Additional CBCT imaging, through surgical confidence, may help to avoid complications and indirectly lead to a shorter surgical time. This study confirmed the clinical usefulness of CBCT for preoperative evaluation and preparation of the way of surgical procedure for impacted mandibular third molars with close relationship to the IAN. Therefore, assessment of inferior alveolar canal by CBCT is the gold standard in predicting neurovascular bundle exposure during impacted mandibular third molar surgery.

COI

The authors declare there is no potential conflict of interest.

Acknowledgment

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References

[1] Dalili, Z., Mahjoub, P. & Sigaroudi, A.K. (2011). Comparison between cone beam computed tomography and panoramic radiography in the assessment of the relationship between the mandibular canal and impacted class C mandibular third molars. *Dental Research Journal*, 8(4), pp. 203-210.

[2] Eyrich, G., Seifert, B., Matthews, F., Matthiessen, U., Heusser, C.K. & Kruse, A.L. (2011). 3-Dimensional imaging for lower third molars: is there an implication for surgical removal? *J Oral Maxillofac Surg*, 69, pp. 1867-1872.

[3] Ghaeminia, H., Meijer, G.J., Soehardi, A., Borstlap, W.A., Mulder, J. & Berge, S.J. (2009). Diagnostic accuracy of cone beam computed tomography compared with panoramic radiography. *Int J Oral Maxillofac Surg*, 38, pp. 964-971.

[4] Ghaeminia, H., Meijer, G.J., Soehardi, A., Borstlap, W.A., Mulder, J., Vlijmen, O.J.C., Berge, S. & Maal, T.J.J. (2011). The use of cone beam CT for the removal of wisdom teeth

changes the surgical approach compared with panoramic radiography. *Int J Oral Maxillofac Surg*, 40(8), pp. 834-839.

[5] Hillerup, S. (2008). Iatrogenic injury to the inferior alveolar nerve: etiology, signs and symptoms, and observations on recovery. *Int J Oral and Maxillofac Surg*, 37, pp. 704-709.

[6] Kavarthapu, A. & Thamaraiselvan, M. (2018). Assessing the variation in course and position of inferior alveolar nerve among south Indian population: A cone beam computed tomographic study. *Indian J Dent Res*, 29(4), pp. 405-409.

[7] Korkmaz, Y.T., Kayipmaz, S., Atasoy, K.T., Gumrukcu, Z. & Senel, K.T. (2017). Does additional cone beam computed tomography decrease the risk of inferior alveolar nerve injury in high-risk cases undergoing third molar surgery? Does CBCT decrease the risk of IAN injury? *Int J Oral and Maxillofac Surg*, 46(5), pp. 628-635.

[8] Loescher, A.R., Smith, K.G. & Robinson, P.P. (2003). Nerve damage and third molar removal. *Oral Surgery*, 30, pp. 375-382.

[9] Meshram, V.S., Meshram, P.V. & Lambade, P. (2013). Assessment of nerve injuries after surgical removal of mandibular third molar: A prospective study. *Asian Journal of Neuroscience*, 13, pp. 291-296.

[10] Nakamori, K., Fujiwara, K., Miyazaki, A., Tomihara, K., Tsuji, M. & Nakami, M. (2008). Clinical assessment of the relationship between the third molar and the inferior alveolar canal using panoramic images and computed tomography. *J Oral Maxillofac Surg*, 66, pp. 2308-2313.

[11] Nasser, A., Alomar, A., Alotaibi, N. & Altamimi, A. (2018). Correlation of panoramic radiograph and CBCT findings in assessment of relationship between impacted mandibular third molars and mandibular canal in Saudi population. *Dent Oral Craniofac Res*, 4(4), pp. 1-5.

[12] Neves, F.S., Souza, T.C., Almeida, S.M., Haiter-Neto, F., Freitas, D.Q. & Bo´scolo, F.N. (2012). Correlation of panoramic radiography and cone beam CT findings in the assessment of the relationship between impacted mandibular third molars and the mandibular canal. Dentomaxillofac Radiol, 41, pp. 553-557.

[13] Pauwels, R., Araki, K., Siewerdsen, J. H. & Thongvigitmanee, S. S. (2015). Technical aspects of dental CBCT: state of the art. *Dentomaxillofac Radiol*, 44(1), pp. 1-20.

[14] Pippi, R., Santoro, M. & D'Ambrosio, F. (2016). Accuracy of Cone-Beam Computed Tomography in defining spatial relationships between third molar roots and inferior alveolar nerve. *Eur J Dent*, 10(4), pp. 454-458.

[15] Tantanapornkul, W., Okouchi, K., Fujiwara, Y., Yamashiro, M. & Maruoka, Y. (2007). A comparative study of cone-beam computed tomography and conventional panoramic radiography in assessing the topographic relationship between the mandibular canal and impacted third molars. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 103, pp. 253-259.

[16] Tay, A.B.G. & Go, W.S. (2004). Effect of exposed inferior alveolar neurovascular bundle during surgical removal of impacted lower third molars. *J Oral Maxillofac Surg*, 62(5), pp. 592-600.

[17] Wang, D., He, X., Wang, Y., Zhou, G., Sun, C., Yang, L., Bai, J., Gao, J., Wu, Y. & Cheng, J. (2016). Topographic relationship between root apex of mesially and horizontally impacted mandibular third molar and lingual plate: cross-sectional analysis using CBCT. *Scientific Reports*, 6, pp. 1-10.

[18] White, S.C. & Pharoah, M.J. (2004). *Oral radiology: Principles and interpretation*. 6th Edition. Mosby, China.

Comparison of N-benzoyl-DL-arginine-β-naphthylamide Scores and Clinical Periodontal Parameters between Smokers and Non-Smokers with Chronic Periodontitis

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Abstract **- Periodontal diseases are a group of inflammatory conditions of the supporting tissues of the teeth that are caused by bacteria leading to a host-inflammatory response. Tobacco smoking is regarded as one of the most significant risk factors for the development and progression of periodontal disease. The present study is aimed to compare the N-benzoyl-DL-arginine-β-naphthylamide (BANA) scores and clinical periodontal parameters between smokers and non-smokers with chronic periodontitis. An analytical non-intervention study was done in 40 subjects (160 sites), 20 subjects (80 sites) were smokers and 20 subjects (80 sites) were non-smokers. Subgingival plaque samples from 4 sites in each subject were taken for microbiological examination of BANA positive species (*Porphyromonas gingivalis*, *Tannerella forsythia* and *Treponema denticola*). BANA (N-benzoyl-DL-arginine-β-naphthylamide) scores and clinical periodontal parameters; Plaque Index (PlI), Gingival Index (GI), Bleeding on Probing Index (BoP index), Probing Pocket Depth (PPD), Clinical Attachment Level (CAL) and Mobility Index (MO) were measured in both groups. As a result, smokers had more teeth with increased mobility and overall increased CAL when compared to non-smokers. There was less bleeding on probing and GI scores in smokers whereas no significant differences of plaque accumulation were found between two groups. Out of 80 sites examined in smokers, 7 sites (8.8%) had BANA score 1, 19 sites (23.7 %) had BANA score 2 and 54 sites (67.5 %) had BANA score 3. Out of 80 sites examined in non-smokers, 28 sites (35%) had BANA score 1, 37 sites (46.3%) had BANA score 2 and 15 sites (18.7%) had BANA score 3. The findings of the present study emphasized that there were greater numbers of BANA positive species in shallow pockets with minimal signs of periodontal inflammation and more severe form of periodontal disease in smokers compared to non-smokers.**

Keywords; BANA (N-benzoyl-DL-arginine-β-naphthylamide), BANA positive species, Chronic Periodontitis, Smokers

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Introduction

Periodontitis is defined as an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both (Sreedevi *et al*., 2012). Chronic periodontitis is the most

common form of destructive periodontal disease in adult; it can occur over a wide range of ages. It can occur in both primary and secondary dentitions. It is also characterized by pocket formation and/or gingival recession. It is recognized as most frequently occurring form of periodontitis (Bathla & Bathla, 2011).

In periodontitis, both horizontal and vertical type of bone loss can be found. Tooth mobility also appears in advanced cases with extensive attachment loss and bone loss. The rate of disease progression is usually slow but may be modified by risk factors such as systemic factor, environmental and behavioral risk factors (Newman *et al*., 2012). However, in the presence of systemic factors, environmental and behavioral factors that may modify the host response to plaque accumulation, such as diabetes, smoking and stress, disease progression may become more aggressive (Nayak *et al*., 2010).

Tobacco smoking, mostly in the form of cigarette smoking, is recognized as the important environmental risk factor for periodontal disease. Tobacco smoking affects the oral environment and ecology, the vasculature, the inflammatory response, the immune response and homeostasis and healing potential of the periodontal tissues. On the immune system, neutrophil chemotaxis and phagocytosis are altered. Proinflammatory mediators such as Tumour Necrosis Factor α (TNF-α) and Prostaglandin E_2 (PGE_2) are increased and production of neutrophil collagenase and elastase are also higher in smoker's Gingival Crevicular Fluid (GCF). Nicotine in cigarette suppresses osteoblast proliferation and adversely affects fibroblast functions. Although smoking has no effect on the rate of plaque accumulation, smoking influence progression of periodontal disease by increased colonization of subgingival pathogenic microflora (Bathla & Bathla, 2011).

An analysis of more than 13000 plaque samples, looking for subgingival microorganisms using a DNA-hybridization methodology defined color-coded complexes of periodontal microorganism that tend to be found together in health or disease. These color-coded complexes are yellow or purple complexes, green complexes, orange complexes and red complexes. Among these complexes, the members of the red complex are found in subgingival disease sites, sites with deeper pockets and more advanced lesion (Holt & Ebersole, 2005). The three members of red complexes are *Porphyromonas gingivalis, Tannerella forsythia* (formerly named as *Bacteriodes forsythus*) and *Treponema denticola* (Socransky & Haffajee, 2005).

Identification of specific bacteria as an aid in determination of disease activity and effectiveness of clinical therapy has been frequently emphasized. The detection of bacterial enzymes or enzymatic reactions directly in plaque associated with periodontal disease may therefore be an easy and efficient methods of diagnosis (Gopalakrishnan *et al*., 2012).

The BANA was developed by Dr. Walter Loesche and co-workers at Michigan University, being the result of more than 15 years of research (Loesche *et al*., 1990). The microbial enzymatic BANA test is one of the modern alternatives to bacterial cultures. BANA test is a modern chair-side paraclinical method designed to detect the presence of one or more anaerobic bacteria commonly associated with periodontal disease namely *Porphyromonas*

gingivalis, Tannerella forsythia and *Treponema denticola* in subgingival plaque samples taken from periodontally diseased teeth (Ellen & Galimanas, 2005). Because these bacteria possess an enzyme, capable of hydrolyzing the synthetic trypsin substrate, N-benzoyl-DL-arginine-β-naphthylamide (BANA) (Loesche *et al*., 1990).

Although there are many methods directed at identifying periodontal pathogenic species; microbial cultures, Deoxyribonucleic Acid (DNA) probes and polymerase chain reaction, they require good laboratory equipment and they cannot be used as routine tests. The BANA test is very sensitive, detecting small quantities of pathogens (Puscasasu *et al*., 2006). And BANA is quite effective for detection of red complex organisms and is useful in the initial diagnosis of chronic periodontitis (Rosiash & Aruna, 2012).

Although the red complex bacteria (BANA positive species) can be found in pocket depth which is greater than or equal 5mm, finding from this study can highlight whether BANA positive species can occupied in shallow pocket depth (3-4 mm) and can also evaluate the correlation of subgingival microbiota and their relationship with clinical periodontal parameters. Thus, appropriate treatment plan can be considered to achieve the better outcome of periodontal treatment in smokers and non-smokers.

Materials and Methods

The study population consisted of subjects with chronic periodontitis and age between 35-59 years. Subjects were selected from both genders of patients attending at Department of Periodontology, University of Dental Medicine, Yangon. The analytical non-intervention study was conducted from October 2015 to September 2016. Each subject had received an explanation regarding the study procedure and written informed consent was obtained. Subjects were classified into 2 groups; smokers and non-smokers.

A total of 40 subjects (160 sites), 20 subjects (80 sites) in smokers and 20 subjects (80 sites) in non-smokers were included in this study. Four sites with pocket depth (3-4 mm) in different quadrant in each group were chosen. Subjects with at least 20 natural teeth and having chronic periodontitis were selected. Subjects who regularly smoked at least 5 cigarettes on average per day for at least 3 years and had not quit smoking were chosen as smokers. Former smokers, pregnant women, subjects having systemic conditions that could influence periodontal health (e.g., Diabetes Mellitus), subjects who had received periodontal treatment last 1 month and subjects who had taken any antibiotics medication last 2 weeks were excluded from the study.

Full Mouth Clinical Periodontal Parameters (PlI, GI, BoP index, PPD, MO) were measured and recorded for both groups. Subgingival plaque from each site were analyzed for BANA test with the aids of BANA-Zyme test strip. Supragingival plaque was removed by scaler. Then, the subgingival plaque sample from the selected site was taken with individual sterile Gracey Curette. The adherence plaque sample from curette was placed on the lower matrix of BANA-Zyme test strip. The specific site and corresponding tooth were recorded on the test strip. Above procedure had repeated on other disease tooth sites. The upper matrix was moistened with distilled water using a cotton swab. BANA-Zyme test strip was folded at

crease mark so that lower and upper matrices were met with each other. BANA-Zyme test strip was placed into slot on top of incubator at 55° Celsius for 5 minutes. The BANA-Zyme test strip was removed from the incubator and the lower matrix was discarded. Upper matrix was examined for the presence of any blue color or not. The results of each sample site were recorded.

The BANA test scores are coded as follow:
Score 1 – negative result (no blue color)
Score 2 – weak positive result (faint blue color)
Score 3 – positive result (definite blue color) (Puscasasu *et al*., 2006)

The negative enzymatic reaction (score 1) corresponds to about <1000-5000 colony forming unit. The weak positive enzymatic reaction (score 2) corresponds to about 1000-25000 colony forming unit and the positive enzymatic reaction (score 3) correspond to about ≥25000 colony forming unit.

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Figure 1. Taking plaque sample from patient

Figure 2. BANA Incubator

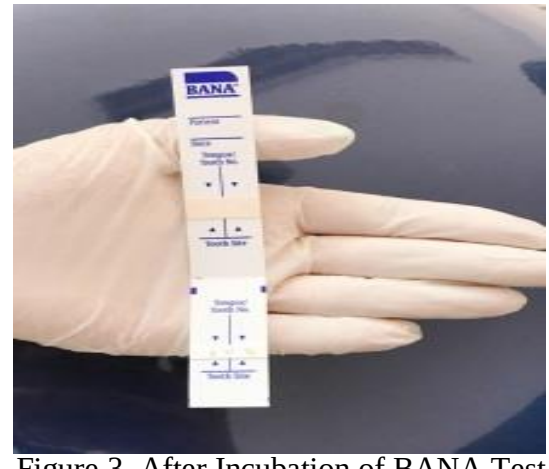

Figure 3. After Incubation of BANA Test Strip

Statistical Analysis

The data were entered into the computer using Microsoft excel and then analyses were carried out using SPSS version 16. Descriptive and summary statistics were carried out. For the categorical data, frequency and percentage were calculated and for the continuous data mean and deviation were calculated. In smokers and non-smokers, plaque index, gingival index, bleeding on probing index, probing pocket depth, clinical attachment level, mobility index and BANA score were compared by 't' test. $p<0.05$ was considered statistically significant.

Results

Mean age of total population of smoker was (47±7.01) year with the range of 36-58 year and non-smoker was (46.5±8.18) year with the range of 35-59 yr. Sex distribution in this study was 5 males and 15 females in non-smokers and all of 20 were male in smokers.

Table 1. The Proportion of Subjects with Mild, Moderate or Severe Periodontitis

Mean CAL (mm)	Smokers		Non-smokers	
	No.	(%)	No.	(%)
1-2mm (Mild periodontitis)	15	18.75%	44	55%
3-4mm (Moderate periodontitis)	37	46.25%	29	36.25 %
≥5mm (Severe periodontitis)	28	35%	7	8.75 %
Total (sites)	80	100%	80	100 %

Table 2. Mean±SD, 't' test and *p* value of PlI, GI, BoP index and MO in smokers and non-smokers
In smokers, n = 80
In non-smokers, n = 80

Score		Mean±SD	t-test	*p*- value
PlI score (score)	Smokers	2.05±0.96	- 0.95	0.34
	Non-smokers	2.18±0.67		
GI score (Score)	Smokers	1.78±1.18	-3.78	< 0.001 *
	Non-smokers	2.35±0.67		
BoP index (Score)	Smokers	1.78±1.18	-3.78	< 0.001 *
	Non-smokers	2.35±0.67		
MO index (Score)	Smokers	0.76±0.95	2.82	0.005 *
	Non-smokers	0.39±0.70		

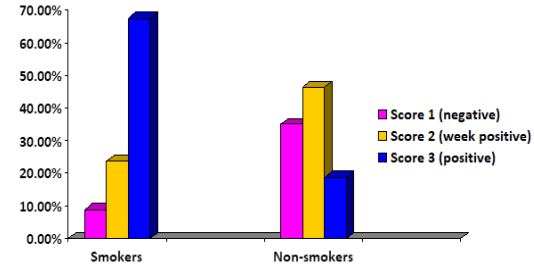

Figure 4. Comparison of BANA Test Scores between smokers and non-smokers

Discussion

Progression and severity of the periodontal disease depends on complex interactions between several risk factors such as microbial, immunological, environmental and genetic factors (Karen & Ibrahim, 2013). Smoking have many impacts on gingival disease such as changes in gingival inflammation, gingival blood flow and oxygen tension (Bathla & Bathla, 2011). Several studies have suggested that if an alteration in microbial changes in smokers exists, it results from a qualitative rather than quantitative alteration in the plaque (Newman *et al*., 2012).

Periodontal microbiota is a complex of microorganisms which play a primary role in initiation and progression of periodontal disease. Although several distinct bacterial species are found in oral cavity, only a finite number of species appear to be associated with the clinical diseases. Most of the suspected periodontal pathogens such as *Porphyromonas gingivalis*, *Tannerella forsythia*, *Treponema denticola* are Gram negative anaerobes and use proteins and peptides as nutrients which possess BANA hydrolytic activity (Ellen & Galimanas, 2005). In 1992, Dr. Loesche introduced a chair-side quick microbial enzymatic test, BANA, in order to assess the present of some

bacterial pathogen species in subgingival plaque (Rosiash & Aruna, 2012).

In this study, mean age of total population of smoker was within 36-58 year and non-smoker was within 35-59 year. Concerning to the sex distribution in this study, there was no female in smoker because only a few females have smoking habit in urban area like Yangon.

In smokers, there were 28 sites examined as severe periodontitis which is 35% of total sites when smokers only had 7 sites (8.75%) which were diagnosed as severe periodontitis. The results indicated that there was an increased attachment loss in smokers when compared to non-smokers. This finding agreed with the previous findings. Sreedevi *et al*. (2012) proved that there was more clinical attachment loss in smokers than non-smokers (Sreedevi *et al*., 2012).

The PlI score of this study revealed no statistical significance between smokers and non-smokers. Although there are controversial in relation to plaque accumulation in smokers, the findings of this study agreed with those of Sreedevi *et al*. (2012).

According to the results, mean value of GI and BoP index score was lower in smokers than in non-smokers. It has long been hypothesized that the peripheral vasoconstrictive effect of tobacco smoke and nicotine reduces gingival blood flow and thereby impairs the delivery of oxygen and nutrients to gingival tissue (Clarke *et al*., 1981). These results were similar with the data reported by Sreedevi *et al.* (2012). The reduced gingival bleeding in smokers may be related more to the suppression of an inflammatory response than to reduced gingival blood flow. Due to these facts, this has implications for potential misdiagnosis and failure to detect periodontitis at an early stage (Rosiash & Aruna, 2012).

Mean value of MO score of this study indicated that there were statistically significant between smokers and non-smokers. These results agreed with Sreedevi *et al*. (2012), showed there was increased mobility in smokers than in non-smokers due to increased destruction of periodontal tissues. Some investigators also found smokers not only had significantly increased probing depth and alveolar bone loss, but also increased tooth mobility (Sreedevi *et al*., 2012).

In this study, out of 80 sites examined in smokers, 54 sites (67.5%) got score 3 when non-smokers had only 15 sites (18.7%). In smokers, 19 sites (23.7%) showed score 2 and 7 sites (8.8%) resulted as score 1. In non-smokers, 37 sites (46.3%) showed score 2 and 28 sites (35%) resulted as score 1. These results showed that there was positive relation between BANA positive species and smokers. The study is in agreement with the studies of Gopalakrishnan *et al*. (2012). The increase prevalence of red complex bacteria (detected by BANA test) was caused by an increased colonization of shallow sites in smokers than non-smokers (Newman *et al*., 2012).

In non-smokers, increased BoP index appears at the early stage of periodontal disease so that further destruction of periodontal tissues can be prevented by appropriate treatment in time. The lower BoP index scores with increased colonization of red complexes, increased clinical attachment level and increased tooth mobility in smokers in this study indicated the silent destruction of periodontal tissues in smokers which can eventually lead to rapid tooth loss.

Conclusion

BANA test is a modern chair side test, quite cheaper and can be used to detect red complex bacteria in subgingival biofilm. Indeed, all species of red complex increased significantly with increasing pocket depths that are greater than or equal 5 mm. In this study, there were more BANA test high scores (Score 3) in smokers in shallow pocket depth 3-4 mm. But level of plaque accumulation was not statistically different between two groups and signs of periodontal inflammation like GI score and BoP index score showed relatively less in smokers. This explains the fact that periodontal disease progresses in smokers without showing noticeable clinical signs of inflammation and can lead to misdiagnose in early stage of periodontal disease. In addition, more clinical attachment loss and higher mean value of mobility indicated the rapid progression of periodontal disease in smokers.

Moreover, the presence of three or four BANA-positive plaques out of the four samples taken could alert the clinician that there is the presence of these bacterial risk factors for periodontal disease which in turn could lead to a more thorough periodontal examination and possibility to the use of interceptive treatments.

The present study was carried out in limited study population within the limited study period. Further studies need to be conducted on a larger population and different demographic area to derive any conclusive results.

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The authors declare there is no potential conflict of interest.

References

[1] Bathla, S. & Bathla, M. (2011). *Periodontics Revisited* .1st Edition. Jaypee Brothers Medical Publishers, India.

[2] Clarke, N.G., Shephard, B.C. & Hirsch, R.S. (1981). The effects of intra-arterial epinephrine and nicotine on gingival circulation. *Oral Surg Oral Med Oral Pathol,* 52(6), pp. 577-582.

[3] Ellen, R.P. & Galimanas, V.B. (2005). Spirochetes at the forefront of periodontal infections. *Periodontology 2000,* 38, pp. 13-32.

[4] Gopalakrishnan, S., Parthiban, S. & Sudhakar, U. (2012). Comparative analysis of periodontal pathogens in smokers and non-smokers with chronic periodontitis-a microbiological study. *International Journal of Dental Clinics,* 4(3), pp. 14-17.

[5] Holt, A.C. & Ebersole, J. (2005). *Porphromonas gingivalis*, *Treponema denticola*, and *Tannerella forsythia*; the red complex, a protype polybacterial pathogenic consortium in periodontitis. *Periodontology 2000,* 38, pp. 72-122.

[6] Karen, B. & Ibrahim, L.M. (2013). Periodontal health status and salivary enzymes level in smokers and non-smokers (comparative, cross sectional study). *Periodontal Health,* 25(3), pp. 91-96.

[7] Loesche, W., Bretz, W.A., Lopatin, D., Stoll, J., Rau, C.F. & Hillenburg, K.L. (1990). Multi-Center Clinical Evaluation of a Chair-side Method for Detecting Certain Periodontopathic Bacteria in Periodontal Disease. *Journal of Periodontology,* 61(3), pp. 189-196.

[8] Nayak, D.G., Uppoor, A. & Mahesh. (2010). *Textbook of Periodontology and Oral Implantology* .1st Edition, India.

[9] Newman, M.G., Takei, H.H., Klokkevold, P.R. & Carranza, F.A. (2012). *Clinical Periodontology*. 11th Edition. Elsevier Inc, California.

[10] Puscasasu, C.G., Dumitriu, A.S. & Dumitriu, H.T. (2006). The significance of BANA test in diagnosis of certain forms of periodontal disease. *Oral Health and Dental Management in the Black Sea Countries*, 5(3), pp. 31-36.

[11] Rosiash, K. & Aruna, K. (2012). BANA hydrolysis as a comparative tool in the evaluation of Amoxicillin and Azithromycin in the treatment of Chronic Periodontitis. *Journal of Periodontology*, 4(2), pp. 43-47.

[12] Socransky, S.S. & Haffajee, A.D. (2005). Periodontal microbial ecology. *Periodontology 2000*, 38, pp. 135-187.

[13] Sreedevi, M., Ramesh, A. & Dwarakanath, C. (2012). Periodontal Status in Smokers and Non-smokers; A Clinical, Micro-biological, and Histopathological Study. *International Journal of Dentistry*, 10, pp. 1-10.

Clinical Efficacy of Subgingivally Delivered Azithromycin Gel in the Treatment of Chronic Periodontitis

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Abstract - **Subgingival administration of chemotherapeutics provides a high concentration of drug in the periodontal pocket and suggests improvement in periodontal health. Azithromycin has a wide range of antimicrobial properties and immunomodulatory properties. The aim of the study was to assess the efficacy of subgingivally delivered 0.5% azithromycin gel as an adjunct in the treatment of chronic periodontitis. Forty patients were randomized and categorized into two treatment groups: nonsurgical periodontal therapy group (Control group) and nonsurgical periodontal therapy plus subgingivally delivered 0.5% Azithromycin gel group (Study group). Clinical periodontal parameters: Plaque Index (PlI), Gingival Index (GI), Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL) were collected at baseline and after 6 weeks. Salivary nitric oxide scores (SNO) (in µmol/L) were also collected at baseline and after 6 weeks to assess the response to current inflammation. Both therapies resulted in significant improvements. During intergroup comparison of mean PPD reduction from baseline to 6 weeks, the greater reduction was observed in study group (1.64±0.64 mm) than in control group (1.10±0.36 mm) and the difference was statistically significant at *p*=0.002. Salivary nitric oxide scores were significantly improved in both groups. Even though both therapies resulted in significant improvements, the adjunctive use of 0.5% azithromycin gel as subgingivally delivered agent could attribute to more enhanced treatment outcomes.**

Keywords: Azithromycin, immune-modulatory, periodontitis, subgingivally delivered, salivary nitric oxide

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Introduction

As periodontitis is the major cause of tooth loss in population worldwide, these individuals are at risk of multiple tooth loss, edentualism and masticatory dysfunction, thereby affecting their nutrition, quality of life and self-esteem as well as imposing huge socio-economic impacts and healthcare costs (Tonetti *et al.*, 2017). The subgingival bacteria contribute directly to tissue damage by the release of noxious substances, but their primary importance in periodontal pathogenesis is that of activating immune–inflammatory responses that, in turn, result in tissue damage, which may well be beneficial to the bacteria located within the

periodontal pocket by providing nutrient sources (Newman *et al*., 2018).

Most cases of chronic periodontitis are successfully managed by mechanical removal/reduction of bacterial mass and calculus in the subgingival environment by scaling and root planning. However, any factor that influences either the local environment or the host response may contribute to disease progression and response to treatment. Due to its numerous and complex contributing factors, successful management of chronic periodontitis can be very challenging (Shaddox & Walker, 2010).

In this regard, safe and intrinsically efficacious medications can be delivered into periodontal pockets to suppress or eradicate the pathogenic microbiota or modulate the inflammatory response, thereby limiting tissue destruction (Mundinamane *et al*., 2011). Moreover, local drug delivery system can provide 100-fold higher concentrations of an antimicrobial agent in subgingival area compared with a systemic drug regimen thereby reducing the total patient dose by over 400-fold avoiding development of drug resistant at non-oral body sites (Goodson, 1994).

Among several antimicrobial agents, Azithromycin (AZM) is a semisynthetic, acid-stable antibiotic and represent the prototype of a novel class of macrolides named azalides. It has a long half-life and good tissue penetration (Foulds *et al.*, 1990). AZM has a wide antimicrobial spectrum of action toward anaerobic bacteria as well as Gram-negative bacilli. It is effective against periodontal pathogens such as *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis* (Pajukanta *et al.*, 1992). It is also effective against *Tannerella forsythia* and *Prevotella intermedia* (Lai, 2015).

It has been known for over 20 years that the macrolide antibiotics, including azithromycin, have immunomodulatory properties. Azithromycin is effective at sites of infection and inflammation because it achieves prolonged, high tissue concentrations despite low serum levels (Bartold *et al*., 2013). Macrolides decrease the formation of pro-inflammatory cytokines and promote the release of anti-inflammatory cytokines (Culic *et al*., 2001). Macrolides have been demonstrated to inhibit the mRNA expression for RANKL and NF-κB (Bartold *et al*., 2013).

Periodontal diagnoses are determined by analyzing the information collected during a periodontal examination. In addition to clinical periodontal parameters, oral fluid based biomarkers can provide important complimentary diagnostic information and can be used as tests for screening diagnosis, prognosis and predicting periodontal disease progression (Ghallab, 2018). Among several biochemical markers, nitric oxide has been linked to the etiopathogenesis of periodontal disease and is expressed in salivary glands as well as in their product (Inasu *et al*., 2016). In addition, it can be easily detected in saliva via nitrite being detected by using Griess reagent (Miranda *et al.*, 2001).

Immunomodulatory and antimicrobial properties of Azithromycin suggest its use in diseases containing both infection and inflammation like chronic

periodontitis. In a study by Pradeep *et al.* (2008), it is confirmed that 0.5% Azithromycin gel delivered sub-gingivally maintained concentration above 2.0 µg/ml in gingivocrevicular fluid (GCF) at the end of 28 days that is above minimal inhibitory concentration of AZM against certain periodontal bacteria (Pradeep *et al*., 2008). This study was designed to investigate the efficacy of subgingivally delivered AZM in the indigenously prepared gel as an adjunct in the treatment of chronic periodontitis. Clinical periodontal parameters were used to assess the periodontal status and salivary nitric oxide to assess the response to current inflammation.

Materials and Methods

This randomized controlled trial was conducted at the University of Dental Medicine, Yangon from September, 2017 to August, 2018 after approval from Research and Ethical Committee of the institution. The subjects for this study were selected from volunteer patients attending at the Department of Periodontology, University of Dental Medicine, Yangon. Forty-four subjects of both genders with age limit of 35-59 years having localized moderate chronic periodontitis were included in the study.

Exclusion criteria were tooth with angular bony defects, subjects with negative oral health behaviors (e.g., betel quid chewing and smoking habits), subjects who had received periodontal treatment 1 month prior to the study and subjects who had taken any antibiotic medication and any antiseptic mouthwash 2 weeks prior to the study. Pregnant women and lactating mothers, subjects with systemic diseases which have adverse effects on periodontal wound healing and nonsurgical periodontal treatment (e.g., Diabetes Mellitus and bleeding disorders), subjects who had upper respiratory tract infection and subjects who had known allergy to macrolide antibiotics were also excluded from the study. Azithromycin gel was prepared at FAME Pharmaceuticals Industry Co., Ltd, Yangon, Myanmar. In the gel contained Azithromycin as active ingredient, ethanol 96% as solvent for active ingredient, carbomer as thickener for gel base, triethanolamine as pH adjuster, methylparaben as preservative and deionized water as base.

After obtaining the written informed consent form, forty four subjects were randomized into two treatment groups (control group and study group) according to the randomization table. Four diseased teeth with sites exhibiting PPD 3-5 mm were selected from each subject for data collection. At baseline, thorough history taking and collection of periodontal parameters were done. PPD and CAL were measured by using the Michigan O probe with William's markings (Figure 1). Salivary nitric oxide scores were collected by using the Berkeley salivary nitric oxide test strips following the manufacturer's instructions (Figure 2).

All study subjects were given nonsurgical periodontal therapy. And then, subjects in study group were treated with subgingivally delivered 0.5% Azithromycin gel. For standardization only, 1ml of prepared gel was injected

into periodontal pockets of selected teeth by using the Diaflex syringe (Figure 3). No periodontal dressing was applied after placement of the drug using advantage of viscosity of the gel. Subjects were instructed `to refrain from chewing hard or sticky foods, brushing near the treated areas, or using any interdental aids for 1 week. After 6 weeks, clinical periodontal parameters and salivary nitric oxide scores were recollected.

Statistical Analysis

Statistical analysis was carried out using computer analysis software statistical package for social science (SPSS) (version 16.0). Statistical significance of differences between two groups was determined by Student's *t* test. Statistical significance of differences of before and after treatment for each group was determined by Paired *t* test. Statistical significance was considered at $p<0.05$.

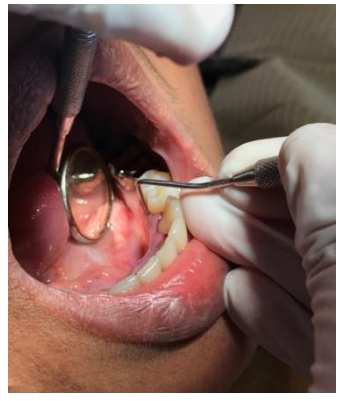

Figure 1. Measuring probing pocket depth

Figure 2. Berkeley salivary nitric oxide test

Figure 3. Subgingival delivery of Azithromycin gel

Results

In this present study, 44 subjects were randomly collected at baseline but 4 subjects failed to follow up. A total of 40 subjects: 5 males and 15 females in control group and 8 males and 12 females in study group completed the study. No adverse reaction was observed in any subject from study group and no subject reported any discomfort.

No statistically significant difference in baseline values was observed between two groups (Table 3). All periodontal parameters were significantly improved

after 6 weeks compared to baseline in both groups (Table 1, 2).

After 6 weeks, the reduction in PlI is greater in study group than in control group but it was not statistically significant (Table 4). In addition, reduction in mean GI scores was greater in study group compared to control group after 6 weeks and it reached the significant difference (p=0.004) as shown in Table 4.

The mean PPD decreased from 3.42±0.29 mm to 1.78±0.49 mm in study group (Table 2) and from 3.22±0.35 mm to 2.03±0.31 mm in control group (Table 1). The mean pocket depth reduction from baseline to 6th week was greater in study group (1.64±0.64 mm) than in control group (1.10±0.58 mm). The intergroup comparison between mean pocket depth reduction showed significant difference (p=0.002).

The mean values of CAL at baseline and 6 weeks for both groups are presented in Table 1 and Table 2. Mean values of CAL gain from baseline to 6 weeks were 0.58±0.46 mm in control group and 1.11±0.58 mm in study group. When comparing CAL gain from baseline to 6 weeks between control group and study group, the difference was being statistically significant at p=0.003.

Salivary nitric oxide scores were decreased in both groups after treatment compared to baseline with a greater decrease in study group. However, the decrease did not reach the level of significance during intergroup comparison (Table 4).

Table 1. Comparison of periodontal parameters between baseline and after 6 weeks in control group (n=20)

Periodontal parameters	Time	Mean	SD	*p*- value
PlI	Baseline	2.15	0.31	0.00*
	6 weeks	1.13	0.24	
GI	Baseline	1.82	0.21	0.00*
	6 weeks	1.19	0.24	
PPD (mm)	Baseline	3.22	0.35	0.00*
	6 weeks	2.03	0.31	
CAL (mm)	Baseline	3.57	0.73	0.00*
	6 weeks	3.01	0.96	
SNO (µmol/L)	Baseline	99.70	54.79	0.01*
	6 weeks	65.25	42.32	

*Paired *t* test

Table 2. Comparison of periodontal parameters between baseline and after 6 weeks in study group (n=20)

Periodontal parameters	Time	Mean	SD	*p*-value
PlI	Baseline	2.27	0.33	0.00*
	6 weeks	0.99	0.26	
GI	Baseline	1.81	0.24	0.00*
	6 weeks	0.97	0.21	
PPD (mm)	Baseline	3.42	0.29	0.00*
	6 weeks	1.78	0.49	
CAL (mm)	Baseline	3.74	0.46	0.00*
	6 weeks	2.63	0.65	
SNO (µmol/L)	Baseline	148.50	103.92	0.03*
	6 weeks	62.05	39.59	

*Paired *t* test

Table 3. Comparison of periodontal parameters between control group and study group at baseline (n=40)

Periodontal parameters	Group	Mean	SD	*p*-value
PlI	Control	2.15	0.31	0.24
	Study	2.27	0.33	
GI	Control	1.82	0.21	0.93
	Study	1.81	0.24	
PPD (mm)	Control	3.22	0.35	0.06
	Study	3.42	0.29	
CAL (mm)	Control	3.57	0.73	0.36
	Study	3.74	0.46	
SNO (µmol/L)	Control	99.70	54.79	0.07
	Study	148.50	103.92	

*Student's *t* test

Table 4. Comparison of periodontal parameters between control group and study group after 6 weeks (n=40)

Periodontal parameters	Group	Mean	SD	*p*-value
PlI	Control	1.13	0.24	0.076
	Study	0.99	0.26	
GI	Control	1.19	0.24	0.004*
	Study	0.97	0.21	
PPD (mm)	Control	2.03	0.31	0.065
	Study	1.78	0.49	
CAL (mm)	Control	3.01	0.96	0.152
	Study	2.63	0.65	
SNO (µmol/L)	Control	65.25	42.32	0.81
	Study	62.05	39.59	

*Student's *t* test

Discussion

The therapeutic goal in the successful treatment of chronic periodontitis includes the ability to alter or eliminate the bacteria that cause the infection, with control of inflammation and to prevent any further tissue destruction (Renatus *et al.*, 2016). In the recent years, effectiveness of adjunctive use of azithromycin along with scaling and root planning has been studied and showed improved therapeutic outcomes.

Whether to administer an antibiotic systemically or locally is of great clinical importance. The long term use of systemic antibiotics may be associated with lack of patient compliance and potential side effects likes development of resistant strains and superimposed infections. Whereas, a subgingivally delivered agent can be used as an adjunct in the treatment of a few, localized non-responding sites in an otherwise controlled patient.

In a study by Pradeep *et al.* (2008), subgingivally delivered 0.5% Azithromycin gel combined with scaling and root planning in treatment of chronic periodontitis provided significantly greater pocket depth reduction and clinical attachment gain after therapy than SRP alone (Pradeep *et al.*, 2008).

Dodwad and colleagues studied the clinical efficacy of subgingivally delivered controlled released 0.5% Azithromycin gel in 4-6 mm pockets between two treatment groups (SRP plus AZM gel group and SRP only group) at baseline and 21 days. Their study resulted in significantly better improvements of GI, PlI, and PPD and CAL in SRP plus AZM gel group (Dodwad *et al.*, 2012).

Mahesh *et al.* (2013) evaluated clinical and microbiological effectiveness of locally delivered 0.5% Azithromycin gel in management of

chronic periodontitis. In their study, GI and PPD were significantly reduced in the test group than in control group, however, differences in CAL gain and microbiological parameters were not significant during intergroup comparison (Mahesh *et al*., 2013).

Pradeep and coworkers also evaluated the effects of 0.5% Azithromycin gel in the treatment of chronic periodontitis among smokers. Intergroup comparison between AZM group and placebo group showed significant improvement of PPD reduction and CAL gain in AZM group but not in mean sulcus bleeding index (Pradeep *et al.*, 2013).

During intergroup comparison, greater plaque index scores reduction in study group could result from antimicrobial properties of Azithromycin like reduction of bacterial adhesion, the first step for bacterial colonization and inhibitory effects on bacterial biofilm.

Gingival index scores reduction was greater in study group compared to control group (0.98±0.21 and 1.19±0.24 respectively) and it was statistically significant at $p<0.05$. This results were consistent with the study conducted by Mahesh *et al*. (2013). Statistically significant reduction of gingival index scores in study group than in control group during intergroup comparion could be due to anti-inflammatory effects of Azithromycin in addition to its antimicrobial properties.

The mean pocket depth reduction from baseline to 6 weeks in study group was 1.64±0.64 mm. The intergroup comparison of mean pocket depth reduction between two groups showed significant difference ($p=0.002$). The present findings are in line with the results of other studies using Azithromycin gel as they also showed significant reduction of PPD in test group than in control group (Dodwad *et al*., 2012; Mahesh *et al*., 2013; Pradeep *et al*., 2008; Pradeep *et al*., 2013).

The mean clinical attachment gain from baseline to 6 weeks was 0.58±0.46 mm in control group and 1.11±0.58 mm in study group. The difference was being statistically significant at $p=0.003$. The present findings reached consensus with other studies where clinical attachment level gains were around 1mm after treated with scaling and root planing together with the Azithromycin gel (Dodwad *et al.*, 2012; Pradeep *et al.*, 2008; Pradeep *et al.*, 2013).

Significant reduction of PPD and CAL gain in study group than in control group point out the efficacy of the Azithromycin gel in controlling the bacteria deep in the gingival tissues and dentinal tubules and bold the efficacy of the gel in modulating the host immune responses.

There are several reports on anti-inflammatory and immunomodulatory properties of AZM (Bartold *et al.*, 2013; Hirsh *et al.*, 2012). In this study, salivary nitric oxide was evaluated to assess the response to current inflammation. Although both group lead to significant reduction of salivary nitric oxide after the treatment, the difference in salivary nitric oxide reduction between two group has not reached the level of significance.

The nitric oxide in the saliva is produced by three enzymes namely neuronal nitric oxide synthase,

endothelial nitric oxide synthase and inducible nitric oxide synthase. The first two are constitutively expressed and the third one is induced by immunological stimuli (Reher *et al.*, 2007). So, its levels are effected by oral environmental health, lifestyle and diet behaviors. Although this study excluded the presence of infection in surrounding oral environment, effected by eating styles and habits, maintenance of healthy lifestyle and exercises in different people and socio-economical status, salivary nitric oxide levels could be varied.

The articles about salivary nitric oxide estimation after subgingival delivery of Azithromycin does not exist. However, Parwani *et al*. (2012) and Samani *et al*. (2012) reported significant reduction of salivary nitric oxide after nonsurgical periodontal therapy in chronic periodontitis. However, their studies cannot directly compared with this study because of different study design and different population. The current study cannot also estimate whether salivary nitric oxide scores were reduced to the level of clinically healthy gingiva.

In this present study, both therapies resulted in significant improvements of all clinical periodontal parameters and salivary nitric oxide scores after 6 weeks. During intergroup comparison, reduction of PPD, and CAL gain were greater in study group than in control group and the differences were statistically significant. This indicates nonsurgical periodontal therapy with subgingivally delivered Azithromycin gel as an adjunct has a better efficacy in the treatment of chronic periodontitis.

Conclusion

The adjunctive use of subgingivally delivered 0.5% Azithromycin gel compared to nonsurgical periodontal therapy alone enhanced the clinical results. Future researches are needed using different vehicles and concentration of Azithromycin in different periodontal pathologies for longer study period to affirm the present study and to know more about the effects of Azithromycin in periodontal tissues and microbiota. Salivary nitric oxide could be used in determining the extent of periodontal inflammation. Moreover, further studies of salivary nitric oxide scores are needed to determine the standard salivary nitric oxide scores of normal healthy gingiva.

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The authors declare there is no potential conflict of interest.

References

[1] Bartold, P.M., du Bios, A.H., Gannon, S., Haynes, D.R. & Hirsh, R.S. (2013). Antibacterial and immunomodulatory properties of azithromycin treatment implications for periodontitis. *Inflammopharmacology*, 21, pp. 321-338.

[2] Culic, O., Erakovic, V. & Parnham, M. (2001). Anti-inflammatory effects of macrolide antibiotics. *European Journal of Pharmacology*, 429, pp. 209-229.

[3] Dodwad, V., Vaish, S. & Tyagi, P. (2012). Clinical efficacy of subgingivally delivered 0.5% controlled release azithromycin gel in the management of chronic periodontitis. *Journal of*

Pharmaceutical and Biomedical Sciences, 20(18), pp. 1-5.

[4] Foulds, G., Shephard, R. & Johnson, R. (1990). The pharmacokinetics of azithromycin in human serum and tissues. *Journal of Antimicrobial Chemotherapy*, 25(Suppl A), pp. 73-82.

[5] Ghallab, N.A. (2018). Diagnostic potential and future directions of biomarkers in gingival crevicular fluid and saliva of periodontal diseases: review of the current evidence. *Archives of Oral Biology*, 87, pp. 115-124.

[6] Goodson, J.M. (1994). Antimicrobial strategies for treatment of periodontal diseases. *Periodontology 2000*, pp. 142-168.

[7] Hirsch, R., Deng, H. & Laohachai, M.N. (2012). Azithromycin in periodontal treatment: more than an antibiotic. *Journal of Periodontal Research*, 47, pp. 137-148.

[8] Inasu, S., Thomas, B., Kumari, S., Ramesh, A. & Rao, A.S. (2016). Evaluation of serum and salivary sialic acid and nitric oxide levels in chronic periodontitis patients. *International Journal of Applied Dental Sciences*, 2(2), pp. 74-76.

[9] Lai, P.C. (2015). *Azithromycin in periodontal therapy: pharmacokinetic and mechanistic investigations.* Ph.D. Dissertation, Ohio State University, United States of America.

[10] Mahesh, C., Jaydeep, M. & Shefeli, S. (2013). 0.5% Azithromycin gel a local drug delivery system in management of chronic periodontitis. *Indian Journal of Basic and Applied Medical Research*, 2(8), pp. 1121-1130.

[11] Miranda, K.M., Espey, M.G. & Wink, D.A. (2001). A rapid, simple spectrophotometric method for simultaneous detection of nitrate and nitrite. *Nitric Oxide*, 5(1), pp. 62-71.

[12] Mundinamane, D.B., Suchetha, A., Venkataraghavan, K. & Garg, A. (2011). Newer trends in local drug delivery for periodontal problems- a review. *International Journal of Comtemporary Dentistry*, 2(4), pp. 59-62.

[13] Newman, M.G., Takei, H.H., Klokkevold, P.R. & Carranza, F.A. (2018). *Newman and Carranza's clinical periodontology.* 13th Edition. Elsevier, China.

[14] Pajukanta, R., Asikainen, S., Saarela, M., Alaluusua, S. & Jousimies-Somer, H. (1992). *In vitro* activity of Azithromycin compared with that of Erythromycin against *Actinobacillus actinomycetemcomitans*. *Antimicrobial Agents Chemotherapy*, 36(6), pp. 1241-1243.

[15] Parwani, S.R., Chitnis, P.J. & Parwani, R.N. (2012). Salivary nitric oxide levels in inflammatory periodontal disease - a case control and interventional study. *International Journal of Dental Hygiene*, 10, pp. 67-73.

[16] Pradeep, A., Vidya Sagar, S. & Daisy, H. (2008). Clinical and microbiologic effects of subgingivally delivered 0.5% Azithromycin in the treatment of chronic periodontitis. *Journal of Periodontology*, 79(11), pp. 2125-2135.

[17] Pradeep, A., Bajaj, P., Agarwal, E., Rao, N.S., Naik, S.B., Kalra, N. & Priyanaka, N. (2013). Local drug delivery of 0.5% Azithromycin in the treatment of chronic periodontitis among smokers. *Australian Dental Journal*, 58, pp. 34-40.

[18] Reher, V.G., Zenobio, E.G., Costa, F.O., Reher, P. & Soares, R.V. (2007). Nitric oxide levels in saliva increase with the severity of chronic periodontitis. *Journal of Oral Science,* 49(4), pp. 271-276.

[19] Renatus, A., Herrmann, J., Schonfelder, A., Schwarzenberger, F. & Jentsch, H. (2016). Clinical efficacy of azithromycin as an adjunctive therapy to non-surgical periodontal treatment of periodontitis: a systematic review and meta-analysis. *Journal of Clinical and Diagnostic Research,* 10(7), pp. 1-7.

[20] Samani, M.K., Poorsatter-Bejehmir, A., Jafari, S., Kashiri, M. & Qujeq, D. (2012). Tracing the success of scaling and root planing (SRP) in patients with chronic periodontitis by salivary nitric oxide. *Caspian Journal of Dental Research,* 1(1), pp. 19-21.

[21] Shaddox, L.M. & Walker, C.B. (2010). Treating chronic periodontitis: current status, challenges, and future directions. *Clinical, Cosmetic and Investigational Dentistry,* 2, pp. 79-91.

[22] Tonetti, M.S., Jepsen, S., Jin, L. & Corgel, J.O. (2017). Impact of the global burden of periodontal diseases on health,nutrition and wellbeing of mankind: a call for global action. *Journal of Clinical Periodontology*, 44(5), pp. 456-462.

Comparison of Pit and Fissure Sealant Retention Between Enameloplasty and Conventional Techniques in Mandibular First Permanent Molars

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Abstract - **Pit and fissure sealant therapy is believed to be effective in caries prevention and success of sealants is directly depending on their retention. Surface cleaning and preparation play an important role in success of fissure sealant therapy. The aim of this study was to compare the retention of Enameloplasty Sealant Technique (EST) and Conventional Sealant Technique (CST) on mandibular first permanent molars. A total number of 22 children of both genders aged between 7 and 9 years old who were attending at University of Dental Medicine, Yangon were selected according to selection criteria. On each subject, mandibular first permanent molars of both sides were filled with fissure sealant by Enameloplasty technique and Conventional technique randomly by using block randomization method. Retention of fissure sealant was assessed at 6-month, 9-month and 12-month intervals by using Simonsen's criteria. The data obtained were tabulated and subjected to statistical analysis using Chi square test. At 6 months, both Enameloplasty technique and Conventional technique showed 100% complete retention. The similar result was found at 9 months and 12 months, Enameloplasty technique had 95.5% complete retention and Conventional technique had 86.4% complete retention. There was not statistically significant difference in retention rates between Enameloplasty technique and Conventional technique at 9 months and 12 months (p>0.05). There was no complete loss of sealant in Enameloplasty technique but two partially loss and one complete loss of sealant in Conventional technique at the end of study period. Although statistical evaluation did not show significant difference, sealant retention was increased after Enameloplasty technique which may be due to small sample size in this study. Furthermore, clinical studies (larger sample size and long-term follow-up) are still required to ensure that EST is more effective than CST.**

Keywords; conventional sealant technique (CST), enameloplasty sealent technique (EST), mandibular first permanent molars, pit and fissure sealant retention

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Introduction

Development of pit and fissure caries occur not only in 6-14 years old children but also in adolescences and young adult (Asnani, 2010). Especially young permanent molars have been shown to be at an increased risk for caries because of the complex nature of their occlusal surface morphology (Nogourani *et al*.,

2012). Ninety percent of all lesions in first permanent molars have found to be pit and fissure caries (Pinkham *et al*., 2005). The development of caries on occlusal surface of permanent molars soon after eruption, indicated the need for early intervention, that is pit and fissure sealant application (Mohammed *et al*., 2016).

Sealability of fissure sealant highly depends on the integrity of its interface with underlying tooth structure, depends on type of surface preparation performed by the clinician. Thus, success assessment must not be limited to the physical, chemical or biologic properties of sealant materials alone and surface preparation must be taken into account as well. Surface cleaning and preparation play an important role in success of fissure sealant therapy (Pakdel *et al*., 2014).

Enamel preparation is performed to increase retention and prevent microleakage (Borsatto *et al*., 2006). Enameloplasty or fissure enlargement with bur has been advocated as a technique that enhances retention by allowing deeper penetration of etchant and sealant and increase surface area for bonding (Garcia-Godoy & de Araujo, 2014). Fissures preparation with rotary instruments makes deeper fissure accessible; therefore, penetration and adaptation of sealant material can be enhanced. Ripa *et al*. (1996) reported that the bases of occlusal grooves or fissures in molars usually have a prismless enamel layer that should be removed to improve retention of sealants. Therefore, a layer of prismless enamel, which may hinder the effect of etching, can be removed with mechanical enamel preparation (Khogli *et al*., 2012).

Many clinical studies have been reported on the success of pit and fissure sealants with respect to caries reduction. As the longevity of the sealant increases, the retention rate becomes a determinant of its effectiveness as caries preventive measure (McDonald *et al*., 2016). The clinical efficacy of sealant is directly related to their retention effect. Retention rate of conventional technique have been reported to be 95% and 93% after 1 and 3 years, respectively (Pinkham *et al*., 2005). Retention rate of pit and fissure sealant with mechanical preparation was 93% after 2.5 years (Bell & Forsten, 1980).

McDonald & Avery (2011) reported that the effect of sealants in decreasing the incidence of caries depends on their entanglement and soundness of the interface between the enamel and sealant. Therefore, sealants require regular maintenance and repair or replacement to assure success in caries prevention.

Materials and Methods

This randomized controlled clinical trial was conducted at Department of Paediatric Dentistry, University of Dental Medicine, Yangon. Total sample size is 44 teeth (22 children) and study period is 1 year. Healthy co-operative children of both genders between 7-9 years old who has fully erupted and caries free bilateral mandibular first permanent molars in normal occlusal contact with deep retentive pit and fissures were included in this study. Teeth with history of previous sealant application and any other occlusal abnormalities were excluded.

Selected children and their parents or guardians were explained specifically about the study procedure and written consent was obtained before starting study procedure. Both right and left side

of mandibular first permanent molars were randomly received conventional technique as a control group and enameloplasty technique as a test group.

Before sealant application, presence of interproximal caries was assessed by temporary tooth separation. Orthodontic elastomeric separator was placed between the teeth. After 3-4 days, the teeth were separated allowing direct access for examination.

In control group, debris from the pit and fissure was dislodged with dental probe. Fissures were cleaned with dry bristle brush using a low-speed handpiece for approximately 10 seconds. Then the teeth were thoroughly rinsed and isolated with cotton rolls. Then teeth were etched with 35% phosphoric acid for 20 seconds, rinsed with air water spray for 30 seconds and dried with air without oil for 15 seconds. After replacing cotton rolls, then the sealant (Ultra Seal XT hydro) was applied over the occlusal surface according to instructions and light cured for 40 seconds.

In test group, teeth were prepared with fissurotomy burs (18013, STF, SSW) with forward and backward motion to open central fissures. Teeth were isolated with cotton rolls, etched with 35% phosphoric acid for 20 seconds and rinsed with air water spray for 30 seconds and dried with air without oil for 15 seconds. After replacing cotton rolls, then the sealant (Ultra Seal XT hydro) was applied over the occlusal surface according to instruction and light cured for 40 seconds.

The retention was checked with the help of the blunt probe and it was also ensure that all margins were sealed. Occlusion was checked with articulating paper and any premature contacts were adjusted. The patients were instructed not to eat or drink anything for 30 minutes and not to bite or chew on hard substances for the rest of the day. The subjects were recalled at 6-month, 9-month and 12-month intervals to find out the retention of pit and fissure sealant.

The criteria used for evaluation was according to Simonsen's criteria which as follows:

- Complete retention - If some peripheral fissures were uncovered following sealant wear, but no ledges were visible.
- Partially retained (partial loss) - As a result of either wear, or loss of the material, part of a previously sealed pit or fissure was exposed.
- Missing (complete loss) – No trace of sealant is detectable (Simonsen, 1991).

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Figure 1. Fissurotomy bur

Figure 2. Ultraseal XT™ hydro

Statistical Analysis

Statistical Package for Social Science Software (SPSS) (version 22.0) was used for data analysis. Categorical variables were described by frequency and percent. Chi-square test or Fisher's exact test was used for comparison of the retention between the two fissure sealant techniques. Statistical significance was considered as $p<0.05$.

Results

No statistics could be computed for comparison of retention of sealants between Group A and Group B at 6 months follow-up because retention of sealants in both groups at 6 months was constant. The success rate (complete retention) of the sealants at the end of 9-month and 12-month; enameloplasty technique showed 95.5% and conventional technique showed 86.4%. The failure rate (partial loss) of enameloplasty technique was 4.5% and the failure rate (partial loss and complete loss) of conventional technique was 13.6% at the end of 9 months and 12 months.

Table 1. Retention of sealants in Enameloplasty technique group at 6-month, 9-month and 12-month intervals (n=22)

Follow up intervals	Retention	Number (%)
6-month	Complete retention	22 (100)
	Partial loss	0
	Complete loss	0
9-month	Complete retention	21 (95.5)
	Partial loss	1 (4.5)
	Complete loss	0
12-month	Complete retention	21 (95.5)
	Partial loss	1 (4.5)
	Complete loss	0

Table 2. Retention of sealants in Conventional technique group at 6-month, 9-month and 12-month intervals (n=22)

Follow up intervals	Retention	Number (%)
6-month	Complete retention	22 (100)
	Partial loss	0
	Complete loss	0
9-month	Complete retention	19 (86.4)
	Partial loss	2 (9.1)
	Complete loss	1 (4.5)
12-month	Complete retention	19 (86.4)
	Partial loss	2 (9.1)
	Complete loss	1 (4.5)

Figure 3. Complete retention of sealant by EST and CST at 6 months evaluation on same patient

Figure 4. Complete retention by EST and partial loss by CST at 12 months evaluation on same patient

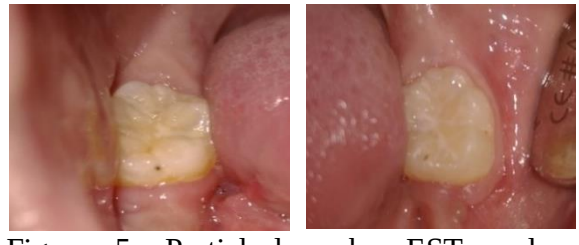

Figure 5. Partial loss by EST and complete retention by CST at 12 months evaluation on same patient

Table 3. Comparison of retention of sealants between Group A (Enameloplasty technique) and Group B (Conventional technique) at 12-month interval (n=22)

Groups	Fissure sealant status		X^2 (df)	*p* value*
	Success	Failure		
Group A	21 (95.5)	1 (4.5)	1.100 (1)	0.303
Group B	19 (86.4)	3 (13.6)		

* Fisher's exact test

Discussion

The preventive effects of the sealant are maintained only as long as it remains completely intact and bonded in place (Waggoner & Seigal, 1996). Optimal bonding of resin fissure sealant depends upon proper and adequate treatment of enamel (Ripa, 1983).

In present study, loss of sealant starts at 9 months after placement. However, Pinkham *et al*. (2005) said that the highest rate of reapplication occurring 6 months following initial sealant application, but contradict to present study which showed good results (100% complete retention) in both EST and CST at 6 months follow-up. In contrast, several authors reported that highest rate of sealant loss is always occur in the first year following placement, due to improperly placement technique (Aguilar *et al*., 2007).

At 9 months and 12 months follow up, EST showed 95.5% complete retention and CST showed 86.4% complete retention in present study. There was decrease retention in CST than EST. The present study might be in line with Nahid *et al*. (2012) who demonstrated EST showed higher retention than CST.

Loss of sealant in CST than EST may be due to remaining debris and pellicle at the base of fissure which interfere the sealant penetration. Newbrun (cited in Agrawal & Shigli, 2012) found that the diameter of the bristle (0.2 mm) is too large to penetrate the orifice of most fissures measuring 0.1 mm wide. So, it cannot completely remove the debris especially in deep, narrow constricted fissure.

According to overall evaluation of the present study, it was not statistically significant although retention rate of EST was higher than CST. The results of the present study were supported by Khanna *et al*. (2009) who found that increase in fissure sealant area after enameloplasty sealant technique. Increase in surface area provides a thicker sealant layer than conventional sealant application that may lead to protection against wear.

Penetration depth is an important parameter that may increase the retention and adaptation of sealant. In the study achieved by Khanna *et al*. (2009) which compare enameloplasty technique with conventional technique via scanning electron microscope, extent of sealant penetration was significantly greater with enameloplasty sealant technique as compared to conventional sealant placement technique, with fewer voids and gaps being evident.

Goldstep (2012) found that traditional cutting burs remove far more enamel at any depth of cut and are more invasive. De Craene *et al*. (1988) in their study compared six types of burs: four various design diamond burs and two steel round burs. They concluded that pointed tip burs create less damage to tooth structure and open the fissure without weakening the tooth. This was consistent with mechanical preparation

with pointed burs showed retention rate of 93% after 2.5 years (Bell & Forsten, 1980).

The fissurotomy burs used for enamolplasty procedures remove irregular enamel surface and fissure related defects, and also prepare an area for restoration or sealing. Fissurotomy burs are available in three different configurations; original bur (head length is 2.5 mm and maximum head diameter is 1.1 mm), micro NTF (narrow taper fissure) (head length is 2.5 mm wide and maximum head diameter is 0.7 mm) and micro STF (shallow taper fissure) (head length is 1.5 mm and maximum head diameter is 0.6 mm). The small and tapered shaped fissurotomy burs (Micro STF, SSW) used in the present study is especially indicated for enameloplasty procedure. It is more conservative and allowed to control the bur tip to cut just below the dentino-enamel junction and no further. It shows minimal heat build-up and vibration, and also minimum discomfort for the patient because it often finished very fast and no need for anaesthesia (Freedman *et al*., 1999).

Under normal conditions, sealant retention has been found to decrease annually by 5%-10% (Feigal, 1998). Clinical evidence suggests that sealant loss occurs in two ways. There is an initial loss due to faulty technique (such as moisture contamination), followed by a second form of loss associated with material wear under the forces of occlusion (Nikiforuk, 1985). However, natural chewing and masticatory forces do not seem to influence the pits and fissure sealants adaptation when enmeloplasty was performed (Zervou *et al*., 2000).

Sealants need regular maintenance; deficient sealants are not effective in caries prevention and addition of sealants is necessary for long-term caries protection. The longest studies on pit and fissure sealant retention have been reported for 10 years or longer. Wendth and Koch (1988) found that after 8 years, about 80% of the sealed fissures showed total sealant retention and no caries. Long term retention of sealant is vital to maintain the success of sealant. The success of fissure sealant depends on its adhesion to enamel and its retention, teeth position in oral cavity, dentist's skill and method can affect the clinical success.

Conclusion

Although there was no statistically significant difference, Enameloplasty technique has potential to have longer retention. Instruments used in Enameloplasty technique are familiar to the dentists and an investment in new equipment is not required. Fissurotomy burs that used in present study for EST are not expensive, innovative bur design and allow quick treatment and give patient comfort. Thus, due to these advantages, it also can be considered as suitable sealant technique even in young children. However, further long-term clinical trials are necessary to determine the clinical longevity of sealant retention is improved by Enameloplasty technique.

COI

The authors declare there is no potential conflict of interest.

References

[1] Agrawal, A. & Shigli, A. (2012). Comparison of six different methods of cleaning and preparing occlusal fissure surface before placement of pit and fissure sealant: An *in vitro* study. *Journal of Indian Society of Pedodontics*

and Preventive Dentistry, 30(1), pp.51-55.

[2] Aguilar, F.G., Drubi-Filho, B., Casemiro, L.A., Watenabe, M.G.C., & Pires-de-Souza, F.C.P. (2007). Retention and penetration of a conventional resin-based sealant and a photochromatic flowable composite resin placed on occlusal pits and fissures. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 25(4), pp. 169-173.

[3] Asnani, K.H. (2010). *Essentials of paediatric dentistry.* 1st Edition. Jaypee Brothers Medical Publishers, New Delhi.

[4] Bell, Y.L. & Forsten, L. (1980). Sealing of preventively enlarged fissures. *Acta Odontologica Scandinavica*, 38(2), pp. 101-104.

[5] Borsatto, M.C., Corona, S.A.M. & Chinelatti, M.A. *et al*. (2006). Comparison of marginal microleakage of flowable composite restorations in primary molars prepared by high-speed carbide bur, Er:YAG laser, and air abrasion. *Journal of Dentistry for Children*, 73(2), pp. 122-126.

[6] De Craene, G.P., Martens, C. & Dermaut, R. (1988). The invasive pit-and-fissure sealing technique in pediatric dentistry: an SEM study of a preventive restoration. *Journal of Dentistry for Children*, 55(1), pp. 34-42.

[7] Feigal, R.J. (1998). Sealants and preventive restorations: review of effectiveness and clinical changes for improvement. *Pediatric Dentistry*, 20(2), pp. 85-92.

[8] Freedman, G., Goldstep, F., Seif, T. & Pakroo, J. (1999). Ultraconservative resin restorations. *Journal of the Canadian Dental Association*, 65(10), pp. 579-581.

[9] Garcia-Godoy, F. & de Araujo, F.B. (2014). Enhancement of fissure sealant penetration and adaptation: The enameloplasty technique. *The journal of clinical pediatric dentistry.* 19(1), pp. 13-18.

[10] Goldstep, F. (2012). The perimeter preparation. *Oral Health*, pp. 18-21.

[11] Khanna, R., Pandey, R.K., Singh, N. & Agarwal, A. (2009). A comparison of enameloplasty sealant technique with conventional sealant technique: A scanning electron microscope study. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 27(3), pp. 158-163.

[12] Khogli, A.E., Cauwels, R., Vercruysse, C. & Verbeeck, R. (2012). Microleakage and penetration of a hydrophilic sealant and a conventional resin-based sealant as a function of preparation techniques: a laboratory study. *International Journal of Paediatric Dentistry*, 23(1), pp. 1-10.

[13] McDonald, R.E. & Avery, D.R. (2011). Dentistry for the child and adolescent. 8th Edition. Philadelphia, Mosby.

[14] McDonald, R.E., Avery, D.R. & Dean, J.A. (2016). *Dentistry for the child and adolescent.* 10th Edition. Elseiver, Missouri.

[15] Mohammed, I. P., Jaleel, B. N. F., Hiremath, S. S., Manjunath, C., Amarah, U. & Krishamoorthy, A. (2016). Comparison of effectiveness of traditional acid etching and of the self-etching agent in sealant retention: A randomized controlled trial. *Journal of Indian Association of Public Health Dentistry*, 14(1), pp. 4-9.

[16] Nahid, A., Zahra, B.G. & Yasaman, R. (2012). Evaluation of the effect of enamel preparation on retention rate of fissure. *Contemporary Clinical Dentistry*, 3(4), pp. 380-382.

[17] Nikiforuk, G. (1985). *Occlusal sealants. Understanding Dental Caries.* Basel, Switzerland: Karger, pp. 145-173.

[18] Nogourani, M.K., Janghorbani, M., Khadem, P., Jadidi, Z. & Jalali, S. (2012). A 12 month clinical evaluation of pit and fissure sealants placed with and without etch and rinse and self-etch adhesive systems in newly-erupted teeth. *Journal of Applied Oral Science*, 20(3), pp. 352-356.

[19] Pakdel, A., Partovi, S., Sandra, E., Rezvani, S., Valayi, N. & Motamedi, M.K. (2014). Effect of different enamel preparation methods on microleakage of fissure sealant: An *in vitro* study. *Journal of Dental School*, 32(4), pp. 216-221.

[20] Pinkham, J., Casamassimo, P., Fields, H., McTigue, D. & Nowak, A. (2005). *Paediatric dentistry: Infancy through adolescence*. 4th Edition. Elsevier Saunders, Missouri.

[21] Ripa, L.W. (1983). Occlusal sealants: An overview of clinical studies. *Journal of Public Health Dentistry*, 43(3), pp. 216-225.

[22] Ripa, L.W., Gwinnett, A.J. & Buonocore, M.G. (1996). The "prismless" outer layer of deciduous and permanent enamel. *Archives of Oral Biology*, 11, pp. 41-48.

[23] Simonsen, R.J. (1991). Retention and effectiveness of dental sealant after 15 years. *Journal of American Dental Association*, 122, pp. 34-42.

[24] Waggoner, W.F. & Siegal, M. (1996). Pit and fissure application: updating the technique. *Journal of American Dental Association*, 127, pp. 351-361.

[25] Wendth, L.K. & Koch, G. (1988). Fissure sealant in permanent first molar after 10 years. *Swedish Dental Journal*, 12, pp. 181-185.

[26] Zervou, C., Kugel, G., Leone, C., Zavras, A., Doherty, E.H. & White, G.E. (2000). Enameloplasty effects on microleakage of pit and fissure sealants under load: an *in vitro* study. *The journal of Clinical Pediatric Dentistry*, 24(4), pp. 279-285.

Effectiveness of *Allium sativum* Oil in Non-vital Pulpotomy of Deciduous Mandibular Molars

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***Abstract* - Pulpotomy is the most widely used endodontic technique in primary dentition. Formocresol is a popular pulpototmy medicament although concern about the safety of it. A demand for natural medicament to replace formocresol as a pulp dressing material become compulsory. Historically, garlic (*Allium sativum*) has been used around the world to treat many conditions and it is one of the most extensively researched medical plants. The aim of this study was to compare the effectiveness of *Allium sativum* oil and formocresol in non-vital pulpotomy of deciduous mandibular molars. This study was conducted at Department of Paediatric Dentistry, University of Dental Medicine, Yangon. A total of 38 deciduous mandibular molars were selected one from each child between the ages of 5-8 according to inclusion criteria. They were randomly assigned to two groups as Group A (*A. sativum*) and Group B (formocresol) by balance randomization method. After pulpotomy was performed, *A. sativum* oil and formocresol were applied onto the radicular pulp stump in Group A and Group B respectively. Then the pulp chamber was filled with polymer reinforced zinc oxide eugenol and finally restored by stainless steel crown. Clinical and radiographic evaluation was done at 3-month and 6-month after the intervention. Clinical success rate was 100% for both Group A and Group B at 3-month follow-up. At 6-month follow-up, success rate of Group A was 94.7% and Group B was 100% clinically. Radiographic success rate of Group A was 84.2% and Group B was 84.2% at 3-month. Radiographic success rate at 6-month was 78.9% for both groups. Fisher's exact test was used to compare the two groups. It was found that there was no statistically difference between two groups (*p*=1.000). Therefore, *A. sativum* oil can be used as a replacement of formocresol in non-vital pulpotomy.**

Keywords; Allium sativum oil, formocresol, non-vital pulpotomy

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Introduction

Good oral health is vital role and integral component of good general health. Although enjoying good oral health includes more than just having healthy teeth, many children have inadequate oral and general health because of active and uncontrolled dental caries. The World Health Organization (WHO) reported that 60-90% of school children experience caries globally (Yang *et al*., 2015). As a result, many primary teeth are still loss prematurely. Early loss of primary teeth through trauma or infection was likely to destabilize the developing occlusion.

Clarice (2013) reported that early removal of primary teeth is not

recommended. It is important to maintain the primary dentition in the dental arch, provided that it can be restored to function and remained free from disease. Therefore, maintaining of primary teeth to keep a functioning tooth in site is one of the most frequent problems in paediatric dentistry. To solve this problem, pulpotomy therapy was introduced and developed. Robert (1996) examined the different treatment approaches for non-vital/irreversibly inflamed pulps, rather than pulpectomy. Because pulpectomy in deciduous molars is often impractical due to root canal morphology of multi-rooted primary teeth is more complex than permanent teeth (Cameron & Windmer, 2013). So non-vital pulpotomy is preferred by clinicians.

Non-vital pulpotomy using zinc oxide formocresol paste was attempted, with a success rate of 84.8% (Ranly, 1994). Formocresol has been used in dentistry since 100 years. Kim *et al*. (cited in Chandrashekhar & Shashidhar, 2014) concerns about the safety of formocresol have been appearing in the dental and medical literature for more than 20 years. Therefore, the dental profession has looked for alternatives pulpotomy medicaments that are both clinically and biologically more acceptable. Concerns about the side effects of conventional medicine, the use of natural products as an alternative to conventional treatment in healing and treatment of various diseases has been on the rise in the last few decades (Dattner, 2003). In this regard, a demand for natural medicament to replace formocresol as a pulp dressing material became imperative.

Among the promising medicinal plants, *Allium sativum* is considered to be an amazing herb with a rich historical background (Martin & Ernst, 2003). Garlic extract inhibits growth of various gram-positive and gram-negative bacteria and also viruses and fungi (Strika *et al.*, 2017). The inhibitory activity of garlic extract on multidrug-resistant (MDR) strains of *Streptococcus mutans* isolated from human carious teeth has been reported (Fani *et al*., 2007). The garlic oil was found to possess potent analgesic and anti-inflammatory properties and it is used in treatment of toothache without any side effects. The use of garlic in dentistry involves the use of garlic solution as a root canal detergent (Ambareen & Chinappa, 2014) and mouthwash (Bakri & Douglas, 2005). In one study, garlic oil was used in the non-vital pulpotomy of the primary teeth, and success rate was reported as 95% (Mohammad & Baroudi, 2015). In another study, the histological success rate of garlic oil in pulpotomy was higher than that of formocresol (Mohammad *et al.*, 2015).

Due to beneficial effects of *A. sativum* oil and high success rate in non-vital pulpotomy, it can be used as an alternative to formocresol in dentistry. The purpose of this study is to compare the success of non-vital pulpotomy in deciduous mandibular molars by using formocresol and *A. sativum* oil.

Materials and Methods

A total of 38 deciduous mandibular non-vital molars were selected one from each child between aged of 5-8 years old according to inclusion criteria. Detailed treatment plan was explained to their parents or guardians and written consent for the treatment was obtained prior to clinical procedure. The teeth were randomly assigned to Group A and Group B by balanced randomization method. Group A (19 teeth) was treated

with *A. sativum* oil and Group B (19 teeth) was treated with Buckley's formocresol solution (formaldehyde 19%, tricresol 35%, glycerin 15%, water 31%).

All teeth that had been received all the complete procedures of non-vital pulpotomy were examined clinically at 1 week and 1 month. At 3-month and 6-month intervals, both groups were examined and then clinical and radiographic data were collected. The outcome was determined by the clinical signs and symptoms such as postoperative pain, swelling, abscess, fistula, sinus tract, pain on percussion, mobility, and radiographic parameters such as periapical radiolucency, furcation radiolucency, internal resorption and external resorption. Success was assumed if there were no clinical signs and symptoms and reduce or absence of radiolucency or rarefaction. Failure was assumed if pre-existing signs and symptoms were not disappeared or more progress or new occurrence of additional signs and symptoms. If outcome of both clinical and radiographic parameters succeeded, the treated tooth was recorded as a success tooth. If the treated tooth failed in both parameters, it was noted as a failed tooth. This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Figure 1. *Allium sativum* oil (Garlic oil)

Figure 2. Formocresol solution

Statistical Analysis

Data entry and analysis were done by using Statistical Package for the Social Sciences (SPSS) software (version 22.0). Categorical variables were expressed by frequency and percent and analyzed by Fisher's exact test. $p<0.05$ was considered as statistically significant.

Results

Table 1. Comparison of clinical success between Group A and Group B at 3-month and 6-month intervals (n=38)

Treatment group	3-month		6-month	
	Success n (%)	Failed n (%)	Success n (%)	Failed n (%)
Group A	19 (100)	0	18 (94.7)	1 (5.3)
Group A	19 (100)	0	19 (100)	0
p-value*	-		1.000	

*Fisher's exact test

The overall clinical success rate of Group A and Group B were 100% respectively at 3-month as shown in Table 1. No statistics can be computed for comparison of clinical success between two groups at 3-month because clinical success at these different time

intervals was constant. The clinical success rate of Group A was 94.7% and Group B was 100% for 6-month. The Fisher's exact test showed that there were no statistical differences found in the clinical success between the two groups (p=1.000) as shown in Table 1.

Table 2. Comparison of radiographic success between Group A and Group B at 3-month and 6-month intervals (n=38)

Treatment group	3-month		6-month	
	Success n (%)	Failed n (%)	Success n (%)	Failed n (%)
Group A	16 (84.2)	3 (15.8)	15 (78.9)	4 (21.1)
Group A	16 (84.2)	3 (15.8)	15 (78.9)	4 (21.1)
p-value*	1.000		1.000	

*Fisher's exact test

The overall radiographic success rate of *A. sativum* was 84.2% for 3-month and 78.9% for 6-month. The overall radiographic success rate of formocresol was 84.2% for 3-month and 78.9% for 6-month. The Fisher's exact test showed that no statistical differences found in the radiographic outcomes between the two groups (p=1.000) as shown in Table 2.

Table 3. Comparison of total success between Group A and Group B at 3-month and 6-month intervals (n=38)

Treatment group	3-month		6-month	
	Success n (%)	Failed n (%)	Success n (%)	Failed n (%)
Group A	16 (84.2)	3 (15.8)	15 (78.9)	4 (21.1)
Group A	16 (84.2)	3 (15.8)	15 (78.9)	4 (21.1)
p value*	1.000		1.000	

*Fisher's exact test

The overall total success of Group A and Group B was 84.2% at 3-month and 78.9% at 6-month intervals respectively as shown in Table 4. According to Fisher's exact test, p-value was 1.000. There were no significant differences found in total success between the two group at 3-month and 6-month as shown in Table 3.

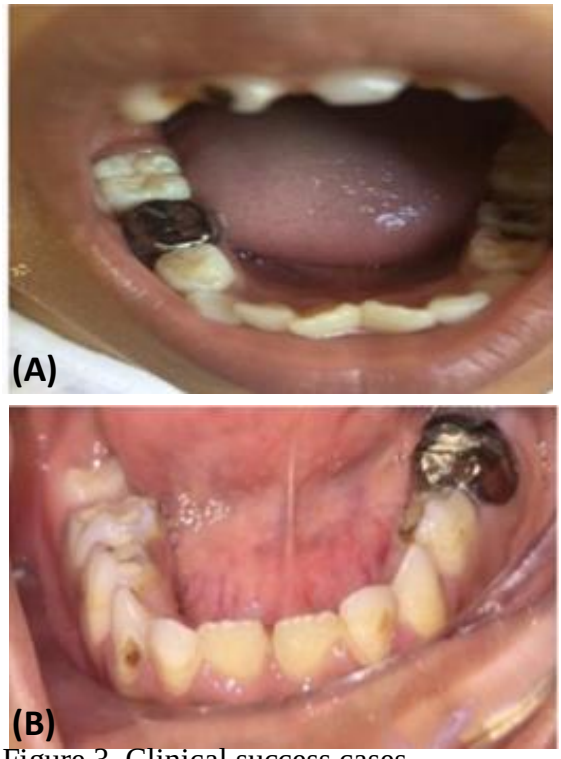

Figure 3. Clinical success cases
(A) *A. sativum* oil
(B) Formocresol pulpotomy

Figure 4. Failure case of non-vital pulpotomy using *A. sativum* oil

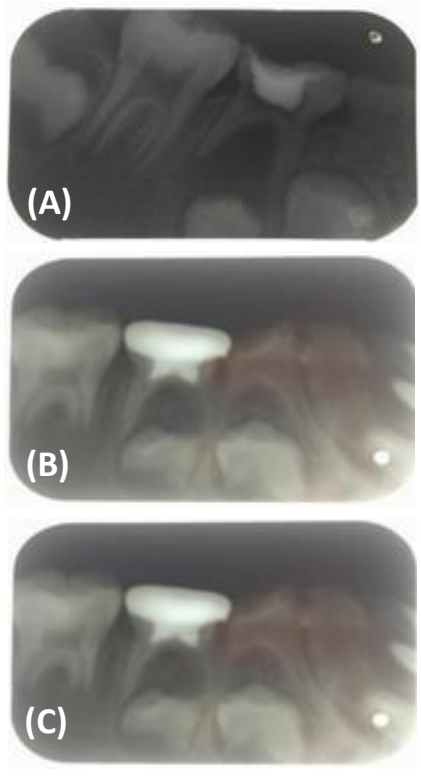

Figure 5. Radiographic success case of non-vital pulpotomy using *A. sativum* oil
(A) Preoperative
(B) 3-month follow-up
(C) 6-month follow-up

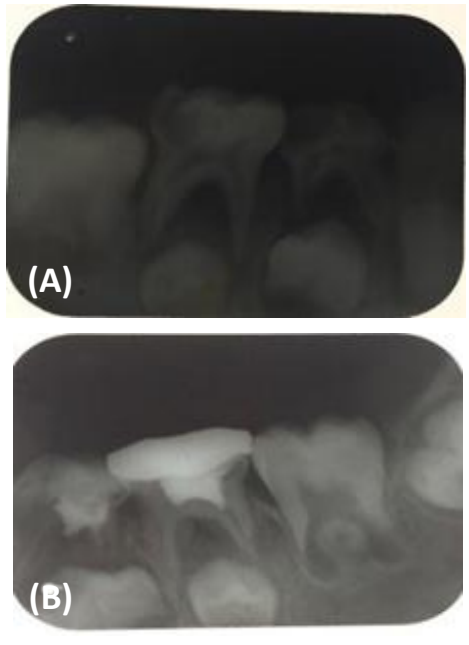

Figure 6. Radiographic success case of non-vital pulpotomy using Formocresol
(A) Preoperative
(B) 3-month follow-up
(C) 6-month follow-up

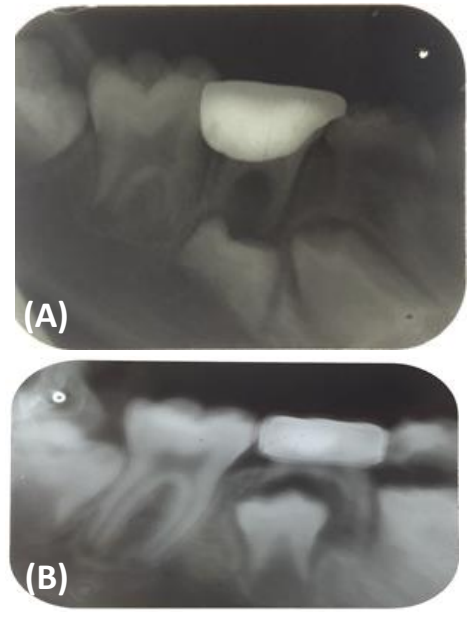

Figure 7. Radiographic failure cases of non-vital pulpotomy using
(A) *A. Sativum* oil
(B) Formocresol

Discussion

Pulpotomy is the most common treatment for primary teeth with pulp involvement because of caries. This method helps maintain the integrity and function of the dental system (Aghazadeh *et al*., 2018). Formocresol,

which is a commonly used material for pulpotomy, has undesirable side effects, such as cytotoxicity, mutagenicity, and carcinogenicity, and replacing it with a safe material seems rational. Despite the penetration of modern medicine, traditional medicine continues to be a viable health alternative for the large underprivileged sections of the world. Among the promising medicinal plants, *A. sativum* is considered to be an amazing herb with a rich historical background. This study was conducted to compare the clinical and radiographic success rate of garlic and formocresol to determine the effectiveness of this novel material for pulpotomy of human primary molars. *A. sativum* is uncommonly used for as a pulpotomy medicaments, there was a very scant data regarding its usage in dental pulp therapy.

In this study, clinical evaluation of Group A was found 100% success rate at 3-month follow-up. But at 6-month follow-up, there was one failure case with the reoccurrence of abscess and got the success rate was 94.7%. The present finding of clinical success rate 94.7% was not much different from Mohammad and Baroudi (2015) where clinical success rate was 90%. From these results, we can make a conclusion that using the *A. sativum* oil is more success in clinical condition.

Radiographic success rate of Group A was 84.2% at 3-month and 78.9% at 6-month intervals. At 3-month, one case was failed with increased in size of furcation radiolucency and two cases were showed external root resorption. One additional failure was root resorption at 6-month. But in Mohammad and Baroudi (2015), the radiographic outcomes of primary molars after 6 months of treatment with *A. sativum* oil, eight had widening in the periodontal membrane space and eight showed periapical radiolucency throughout the follow-up period. Four cases exhibited furcation radiolucency.

For Group B, the clinical success rate was 100% at both 3-month and 6-month intervals. But in Mohammad and Baroudi (2015) study, they got six cases failure in clinically. Two teeth exhibited a draining sinus, gingival inflammation, and mobility. Four cases had pain and tenderness to percussion. After comparing these two studies, the amount of failure cases is not much different. So, we defined that formocresol can used effectively in non-vital pulpotomy.

Radiographic success rate of Group B was 84.2% at 3-month and 78.9% at 6-month recall. At 3-month recall visit, two cases showed presence of root resorption and one case was increase in size of furcation radiolucency. Another failure was presence of external root resorption at 6-month. In Mohammad and Baroudi (2015) study, radiographic outcomes of teeth after 6-month of treatment with formocresol, twelve showed radiographic changes. Widening in the periodontal membrane space, periapical radiolucency was present in twelve cases. Eight cases showed furcation. None of treated molars exhibited root resorption. According to results, more radiographically errors can be seen than that of clinical errors. The reason why we need to realize that there are some problems in radiographically, even clinically asymptomatic tooth. By this current study results, so we found more cases about root resorption in radiographs that for the further studies we need to emphasize the mechanism of root resorption.

This randomized study comparing *A.*

sativum to formocresol as a pulpal medicament of non-vital pulpotomy in primary teeth demonstrates same clinical and radiographic outcomes at 3-month and 6-month. The overall clinical success rate of Group A and Group B were 100% respectively at 3-month. No statistics can be computed for comparison of clinical success between Group A and Group B at 3-month because clinical success at these different time intervals was constant. The clinical success rate of *A. sativum* was 94.7% and formocresol was 100% for 6-month. The overall radiographic success rate of *A. sativum* was 84.2% for 3-month and 78.9% for 6-month. The overall radiographic success rate of formocresol was 84.2% for 3-month and 78.9% for 6-month. There were no significant differences found in both clinical and radiographic outcomes between the two groups at 3-month and 6-month intervals. In one study, Kahvand *et al*. (2019) compared the effect of formocresol and garlic oil in the pulpotomy of the primary teeth and found no significant differences in their success rates. In the 3-month and 6-month follow-up, the clinical success rate was 100% in both groups. The radiographic success rate in the *A. sativum* group was 82.2% after 3 months and 80% after 6 months, and in the formocresol group, after 3-month and 6-month follow-ups, it was 88.9% and 84.4%, respectively. These results are not so much difference with the present findings.

The promising clinical outcome of pulpotomy performed with *A. sativum* oil may be based on potent analgesic and anti-inflammatory properties and it is used in the folk medicine for treatment of toothache without any side effects and also cheap to buy. But the odour of garlic oil is very strong. The clinical and radiographic results revealed success at the aforementioned interval. If the recall periods had been continued longer, complete resolution of these changes would have occurred. There were no significant differences found in both clinical and radiographic outcomes between the two groups at 3-month and 6-month intervals. The usage of *A. sativum* oil in the pulp treatment of non-vital primary molars was promising, this will encourage dentists to use it in the future as an alternative to formocresol. There were few studies concerning with dental usage of *A. sativum* oil. This study will support as a preliminary study for dental use.

Conclusion

Because of the results of this study, clinical and radiographic results of *A.sativum* oil were far beyond expectations and according to formocresol disadvantages, garlic oil is an acceptable alternative. Further long-term evaluation of effectiveness on *A. sativum* oil will be necessary for giving specific conclusions and to know the effectiveness of *A. sativum* oil as this study was only performed on 38 teeth. Although *A. sativum* is cost effective and readily feasible, using it as a medicament in non-vital pulpotomy for deciduous molars, more evidence based clinical trial will be recommended.

COI

The authors declare there is no potential conflict of interest.

References

[1] Aghazadeh, S., Haghgoo, R., Mehran, M. & Kadkhodaei, F. (2018). Comparative evaluation of clinical and radiographic success of MTA and

propolis in pulpotomy of primary molars. *Iranian Endodonict Journal*, 13(4), pp. 508–514.

[2] Ambareen, Z. & Chinappa, A. (2014). Go green - Keep the root canal clean. *International Journal of Dental Sciences and Research*, 2(6B), pp. 21–25.

[3] Bakri, I.M. & Douglas, C.W. (2005). Inhibitory effect of garlic extract on oral bacteria. *Archives of Oral Biology*, 50(7), pp. 645–651.

[4] Cameron, A.C. & Windmer, R.P. (2013). *Handbook of Pediatric Dentistry*. 4th Edition. Mosby Elsevier, Australia.

[5] Chandrashekhar, S. & Shashidhar, J. (2014). Formocresol, still a controversial material for pulpotomy. *Journal of Restorative Dentistry*, 2(3), pp. 114-124.

[6] Clarice. S.L. (2013). Management of premature primary tooth loss in the child patient. *Journal of Califorina Dental Association*, 41(8), pp. 612-618.

[7] Dattner, A.M. (2003). From medical herbalism to phytotherapy in dermatology: Back to future. *Dermatologic Therapy*, 16, pp. 106–113.

[8] Fani, M.M., Kohanteb, J. & Dayaghi, M. (2007). Inhibitory activity of garlic (*Allium sativum*) extract on multidrug-resistant *Streptococcus mutans*. *Journal of Indian Society of Pedodontics and Preventive Dentistry*. 25(4), pp. 164-168.

[9] Kahvand, M., Mehran, M., Haghgoo, R. & Faghihi, T. (2019). Clinical and radiographic evaluation of *allium sativum* oil (garlic oil) in comparison with formocresol in primary molar pulpotomy. *Journal of International society of Preventive and Community Dentistry*, 9(4), pp. 390-395.

[10] Martin, K.W. & Ernst, E. (2003). Herbal medicines for treatment of bacterial infections: A review of controlled clinical trials. *Journal of Antimicrobial Chemotherapy*, 51, pp. 241-246.

[11] Mohammad, S.G. & Baroudi, K. (2015). Assessment of the potential of *Allium sativum* oil as a new medicament for non-vital pulpotomy of primary teeth. *Journal of International Society of Preventive & Community Dentistry*, 5(4), pp. 314-320.

[12] Mohammad, S.G., Raheel, S.A. & Baroudi, K. (2015). Histological evaluation of *Allium sativum* oil as a new medicament for pulp treatment of permanent teeth. *Journal of Contempory Dental Practice*, 16(2), pp. 85–90.

[13] Ranly, D.M. (1994). Pulpotomy therapy in primary teeth: New modalities for old rationales. *Paediatric Dentistry*, 16(6), pp. 403-409.

[14] Roberts, J.F. (1996). Treatment of vital and non-vital primary molar teeth by one-stage formocresol pulpotomy: clinical success and effect upon age at exfoliation. *International Journal of Paediatric Dentistry*, 6(2), pp. 145-152.

[15] Strika, I., Basic, A. & Halilovic, N. (2017). Antimicrobial effects of garlic (*Allium sativum* L.). *Bulletin of the Chemists and Technologists of Bosina and Herzegovia*, 47, pp. 17-20.

[16] Yang, F., Zhang, Y., Yuan, X., Yu, J., Chen, S., Chen, Z., Guo, D., Cai, J., Ma, N. & Guo, E. (2015). Caries experience and its association with the weight status among 8-year-old children in Qingdao, China. *Journal of International Society and Preventive Community Dentistry*, 5(1), pp. 52-58.

Location of Maxillary First Molar Root Canal Orifices and Pulp Chamber Floor relating to Tooth Morphology

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Abstract - **Permanent first molar are the earliest permanent teeth that erupts in the oral cavity at the age of six years and most frequently affected by dental caries requiring endodontic treatment. Clinically seen morpho-logical configure-tions can be used as preoperative prediction of location of internal anatomy of tooth. The aim of this study was to determine the location of root canal orifices and pulp chamber floor relating to tooth morphology of maxillary first molar. It was a cross-sectional descriptive study including 104 extracted permanent maxillary first molars from age of under 40 years patient. Location of root canal orifices in relations to developmental grooves were observed by unaided vision after access cavity preparation and cleaning of the pulp chamber in each tooth. Five distances were measured by digital caliper. The distance between the buccal developmental groove at the occluso-buccal line angle and floor of the pulp chamber from the buccal aspect (A), the distance between the buccal develop-mental groove on the occlusobuccal line angle and mesiodistal midpoint of the cementoenamel junction on the buccal aspect (B), the distance between the buccal developmental groove on the occlusobuccal line angle and the point of root bifurcation on the buccal aspect (C) were measured by using the digital caliper calibrated to 0.01 mm (Mitutoyo, Japan). The distance (D) was calculated by subtracting the distance (B) from (A). The distance (E) was calculated by subtracting the distance (A) from (C). All maxillary first molars had three separate roots and each root had only one root canal orifice (RCO). All mesiobuccal RCOs were situated mesial to buccal developmental groove and lingual developmental groove. Most of the distobuccal RCOs (95.2%) situated distal to buccal developmental groove and only a small portion (4.8%) were in line with it. Regarding the relationship to lingual developmental groove, majority of distobuccal RCOs (83.7%) situated distal while 12.5% were in line and merely 3.8% were mesial to lingual developmental groove. Nearly half of the palatal RCOs (49%) situated distal to and 40.4% were in line with buccal developmental groove whereas 10.6% were mesial to that groove. Concerning the location of palatal RCOs relating to lingual developmental groove, 51% were in line, 36.5% were mesial to and 12.5% were distal to lingual developmental groove. Location of pulp chamber floor was 1.07±0.28 mm above CEJ and 2.81±0.31 mm above root bifurcation. The knowledge of the pulp morphology in relation to external morphology of permanent maxillary first molar may provide the reference information level treatment**

of root canal orifices and floor level of the pulp chamber while performing access cavity preparation in endodontic treatment procedure.

Keywords; location of root canal orifice and floor of pulp chamber, permanent maxillary first molar

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Introduction

The permanent maxillary first molar is the largest tooth in the upper arch and normally located at the center of the fully developed adult jaw anteroposteriorly. As a consequence of the significance of its positions and function, it is considered as the "cornerstones" of the dental arch for development of occlusion (Ash & Nelson, 1993) and is saved by various treatment modalities even it is affected seriously by dental caries (Fuller *et al.*, 1974). Of all the maxillary molars, the first molar is the least variable in anatomic form, and is thus the standard to which the other maxillary molars are compared.

Regarding roots of the permanent maxillary first molar, the root trunk trifurcates into three well developed root branches which are named by their location i.e., mesiobuccal, distobuccal and lingual roots (Ash & Nelson, 1993). The palatal root usually has only one root canal and rarely has more than one apical foramen. The distobuccal root is conical and usually straight and invariably has a single canal. The mesiobuccal root of maxillary first molar has generated more research, clinical investigation and pure frustration than has probably any other root in the mouth (Verma & Love, 2010; Pais, *et al.,* 2012; Habib, 2014).

The clinically seen morphological configurations can be used as preoperative predictors of location of internal anatomies of tooth such as root canal orifices. Thus, a detailed knowledge of these structures is mandatory before more sophisticated management for pulpal disease is begun (Cohen & Burns, 2011).

Among individual teeth, the permanent maxillary first molar is not only one of the two most caries susceptible teeth (Shafer, 1983) but also has a high percentage of caries incidence immediately after eruption (Miyamo, 1974). Thus, a dentist's thorough knowledge of both external and internal anatomies of the tooth is imperative to the preservation of healthy pulp during operative procedure and successful management in case of disease. Attempting to treat the deeper structure of tooth i.e. root canal system without detailed crown morphological description would be likely to sail without a map (Krasner & Rankow, 2003).

Another anatomical landmark using to prevent perforation during root canal treatment is cementoenamel junction (CEJ) that remains constant throughout the life. Its location can be implied by exploring full extent of gingival sulcus or periodontal pocket with any periodontal probe. It is the North Star for locating the pulp chamber and orifices and avoiding common error in treatment of pulp because the distance from the external surface of the clinical crown to the wall of the pulp chamber is the same throughout the surfaces of the tooth at the level of CEJ (Raturi, 2012).

As there is a little data concerning location of root canal orifices and pulp chamber floor of permanent maxillary first molar in Myanmar, the present study will provide the information valuable for endodontic treatment.

Materials and Methods

A cross-sectional descriptive study was carried out involving 104 extracted permanent maxillary first molars from subjects (under 40 years) during 2017-2018.

Selected specimens were identified by morphological characteristics of human permanent maxillary first molars (Wheeler, 1969). Each permanent maxillary first molar was stored in bottles and filled with 10% formalin. Then the teeth were properly washed under tap water and kept in sodium hypochlorite solution (5.25%) for 30 minutes to remove the organic debris from the tooth surfaces so that the developmental grooves and cusps and cementoenamel junction could be clearly seen. The remaining periodontal tissues, bone pieces and calculus on the root surfaces was removed with hand scaler. After that, the teeth were cleaned with tap water and then dried with hot air dryer. Each tooth was kept in the containers with code number.

Access opening was made by using diamond burs (ISO 018 round bur, ISO 160/016 tapering burs) and high-speed hand piece. The coronal pulp tissues were removed until the root canal orifices were seen. Thereafter, the samples were stored in sodium hypochlorite for 7 days for the removal of organic structure of necrotic pulpal tissues in the pulp chamber.

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Location of the Root Canal Orifices in Relation to the Developmental Grooves

The location of the RCOs were determined either mesial or distal to the developmental grooves by unaided vision.

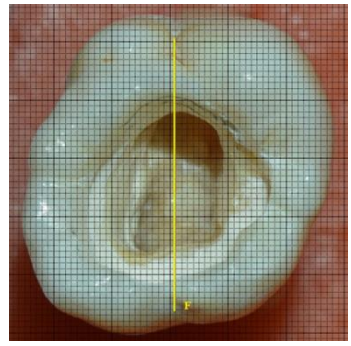

Figure 1. The location of the RCOs were determined either mesial or distal to the developmental grooves

Location of Pulp Chamber Floor in relation to Cementoenamel Junction

The distance (A) between the buccal developmental groove at the occlusobuccal line angle and floor of the pulp chamber from the buccal aspect, the distance (B) between the buccal developmental groove on the occlusobuccal line angle and mesiodistal midpoint of the cementoenamel junction on the buccal aspect, the distance (C) between the buccal developmental groove on the occlusobuccal line angle and the point of root bifurcation on the buccal aspect (Figure 1) were measured by using the digital calliper calibrated to 0.01mm (Mitutoyo, Japan) (Figure 2). The distance between floor of the pulp chamber and cementoenamel junction (D) was calculated by subtracting the distance (B) from (A). The distance between pulp chamber floor and root bifurcation (E) was calculated by subtracting the distance (A) from (C).

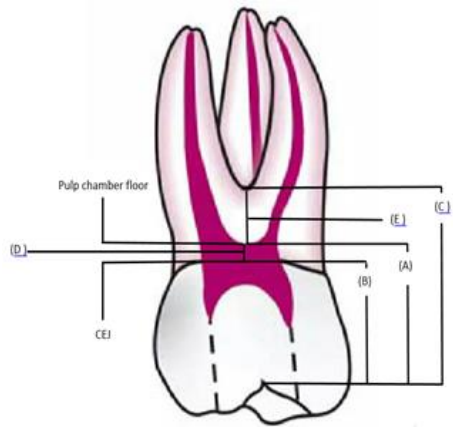

Figure 2. Distance A, B, C, D & E

Figure 3. Digital caliper calibrated to 0.01 mm (Mitutoyo, Japan)

Figure 4. Measurement of distance (A)

Figure 5. Measurement of distance (B)

Figure 6. Measurement of distance (C)

Statistical Analysis

Collected data were entered in Statistical Package for Social Sciences (SPSS) (version 22.0). Categorical variables were described by frequency and percent. Continuous variables (mean SD) were expressed by mean and standard deviation.

Results

Table 1. Location of COs in relation to BDG and LDG in permanent maxillary first molar (n=104)

RCOs	BDG			LDG		
	Mesial to BDG n(%)	Distal to BDG n(%)	In Line with BDG n(%)	Mesial to LDG n(%)	Distal to LDG n(%)	In Line with LDG n(%)
MBRCOs	104 (100)	-	-	104 (100)	-	-
DBRCOs	-	99 (95.2)	5 (4.8)	4 (3.8)	87 (83.7)	13 (12.5)
PRCOs	11 (10.6)	51 (49)	42 (40.4)	38 (36.5)	13 (12.5)	53 (51)

BDG -Buccal Developmental Groove
DBR -Distobuccal Root
DBRCO -Distobuccal Root Canal Orifice
LDG -Lingual Developmental Groove
MBR -Mesiobuccal Root
MBRCO -Mesiobuccal Root Canal Orifice
PR -Palatal Root
PRCO -Palatal Root Canal Orifice
RCO -Root Canal Orifice

Table 2. Distance between of floor of pulp chamber and CEJ (D) and Distance between floor of pulp chamber & root Furcation (E) in permanent maxillary first molar (mm)

Distance	Mean (mm)	Standard Deviation
D	1.07	0.28
E	2.81	0.31

Discussion

The permanent maxillary first molar is the largest tooth in the upper arch. Regarding roots of the permanent maxillary first molar, the root trunk trifurcates into three well developed root branches. Among individual teeth, the permanent maxillary first molar is not only one of the two most caries susceptible teeth (Shafer, 1983). Another anatomical landmark using to prevent perforation during root canal treatment is cementoenamel junction (CEJ). As there is a little data concerning location of root canal orifices and floor of the pulp chamber of permanent maxillay first molar in Myanmar.

In the present study, during access cavity preparation, it was found that the pulp chamber was located in the center of the tooth and floor was found at the level of CEJ, colour of the pulp chamber floor was darker than the walls and the orifices of the root canals were located at the junction of the walls and the floor. These findings were consistent to Law of Colour Change, Law of orifice location 1, Law of orifice location 2 by Vertucci (2005).

Although most common disparity in number of root canal orifices of mesiobuccal root of maxillary first molars were reported in different articles, this study revealed only one root canal orifice in each three roots. It might be due to the fact that localization of root canal orifice was carried out with unaided vision in the present study. Use of special equipment such as dental operating microscope and applying auxiliary procedure including multisonic ultra cleaning may be of assistance to disclose an additional orifice.

In the present study, it was found that all MBRCOs (100%) situated mesial to both BDG and LDG. Major portion of DBRCOs were found distal to both BDG and LDG, i.e. 95.2% and 83.7%, respectively. It was also revealed that greater proportion of PRCOs located distal to the BDG (49.0%) while in relation to LDG, 51.0% of PRCOs were in line with it.

In the present study, it was found

that floor of pulp chamber was 1.07±0.28 mm above CEJ. Knowledge about the distance between floor of the pulp chamber and root bifurcation may help to prevent the accidental furcal perforation during endodontic access.

Majzoub and Kon (1992) measured tooth morphology in maxillary molars following distobuccal root resection procedures and found that the distance from the pulp chamber floor to the most coronal aspect of the area of root separation (furcation) on the distal aspect was equal to or less than 3 mm in 86% of the teeth measured.

Deutsch and Musikant (2004) performed a radiographic study on 100 random human maxillary molars to assess morphological measurements of anatomic landmarks and revealed that pulp floor to furcation measurements in maxillary molars of 3.05 mm (SD of 0.79). The distance between floor of the pulp chamber and root bifurcation 2.56±0.59 mm in the study of Farzanch *et al.* (2004).

Mean distance between floor of pulp chamber and root furcation was 2.81±0.31 mm in the present study, less than the distance of the Majzoub and Kon (1992) study and Deutsch and Musikant (2004) study, and greater than the distance of the Farzanch *et al.* (2004) study.

Conclusion

The findings from this study were helpful in endodontic treatment performing in the developing countries where resources were restricted. The number of root canal orifices in a particular tooth can never be known prior to the commencement of treatment. Although radiographs are helpful and can sometimes indicate the number of roots, and averages have been enumerated, most of the time the number or position of the root canal orifices cannot be identified. The effective and safe way is to visualize the full extent of the pulp chamber floor and use a variety of anatomic landmarks.

COI

The authors declare there is no potential conflict of interest.

References

[1] Al Shalabi, R.M., Omer, O., Glennon, J. & Jennings, M. (2000). Root canal anatomy of maxillary first and second permanent molars. *International Endodontics Journal*, 33(5), pp. 405-414.

[2] Ash, M.M. & Nelson, S.J. (1993). *Wheeler's Dental Anatomy, Physiology and Occlusion*. 7th Edition. W.B. Saunders Company, Philaddphia.

[3] Barbizam, J.V.B., Riberiro, R.G. & Tanomaru-Filho, M. (2004). Unusual anatomy of permanent maxillary molars. *J Endod*, 30, pp. 668-671.

[4] Barrett, M. (1925). The internal anatomy of the teeth with special reference to the pulp and its branches. *Dent Cosmos*, 67, pp. 581-592.

[5] Cleghorn, B.M., Christie, W.H. & Dong, C.C. (2006). Root and root canal morphology of the human permanent maxillary first molar: a literature review. *J Endod*, 32(9), pp. 813-821.

[6] Cohen, S. & Burns, R. C. (2011). *Pathways of the Pulp.* 6th Edition. Elsevier, Netherlands.

[7] Deutsch, S.A. & Musikant, L.B. (2004). Morphological Measurements of Anatomic Landmarks in Human Maxillary and Mandibular Molar Pulp Chambers. *Journal of Endodontics,* 30(6), pp. 388-390.

[8] Diamond, M. (1952). *Dental Anatomy including Anatomy of Head and Neck*. 3rd Edition. McMillan, New York.

[9] Farzaneh, M., Abitbol, S. & Friedman, S. (2004). Treatment outcome in endodontics: the Toronto study. Phases I and II: Orthograde retreatment. *Journal of Endodontics*, 30, pp. 627-633.

[10] Fuller, J.L., Gerald, E.D. & Thomas, M.D. (1974). *Concise Dental Anatomy and Morphology*. 4th Edition. Year Book Medical Publishers, New York.

[11] Ghonchen, Z., Zade, B.M. & Kharazifard, M.J. (2017). Root morphology of the maxillary first and second molars in an Iranian population using cone beam computed tomography. *Journal of Dentistry (Tehran, Iran)*, 14(3), pp. 115-122.

[12] Gray, R. (1983). The maxillary first molar. In Bjomdal, A. & Skidmore, E. (Eds.). *Anatomy and morphology of the human teeth*. University of Iowa College of Dentistry, Iowa City. pp. 31-40.

[13] Habib, A.A. (2014). Anatomical study of the mesiobuccal root in maxillary first molars. *Journal of Taibah University Medical Sciences*, 9(2), pp. 123-125.

[14] Hindlekar, A., Raghavendra, S.S., Vyavahare, N. & Desai, N. (2015). Maxillary first molar with two mesiobuccal roots: Report of a rare case, *Int J Dent Med Res*, 1(6), pp. 94-97.

[15] Krasner, P. & Rankow, H.J. (2003). Anatomy of the Pulp Chamber Floor. *Journal of Endodontics*, 30(1), pp. 5-16.

[16] Libfeld, H. & Rotstein, I. (1989). Incidence of four rooted maxillary second molars: literature review and radiographic survey of 1200 teeth. *J Endod*, 15, pp. 129-131.

[17] Majzoub, Z. & Kon, S. (1992). Tooth morphology following root resection procedures in maxillary first molars. *J Periodontol*, 63, pp. 290-296.

[18] Miyamo, M. (1974). Caries Status in varying stages of emergece up to partial eruption in the first molars. *Koku Eisei Gakkai Zasshi*, 24(3), pp. 235-239.

[19] Pais, A.S., Fontana, C.E., De Martin, A.S., de Carvalho, E.B. & da Silveira, B.C.E. (2012). Location of three canals in the mesiobuccal root of the maxillary first molar. *South Brazilian Dentistry Journal*, 9(3), pp. 322-327.

[20] Raturi, P. (2012). *Unravelling the mysterics of Pulp Chamber*. http://www.medind.inc.in. [Accessed 12 July 2017].

[21] Shafer, W.G. (1983). *A Textbook of Oral Pathology*. 4th Edition. W.B. Saunders Company, Philaddaphia.

[22] Slowey, R.R. (1974). Radiographic Aids in the Detection of Extra Root Canals. *Oral Surg Oral Med Oral Pathol*, 37(5), pp. 762-772.

[23] Thomas, R.P., Moule, A.J. & Bryant, R. (1993). Root canal morphology of maxillary permanent first molar teeth at various ages. *International Endodontic Journal*, 26(5), pp. 257-267.

[24] Vertucci, F.J. (2005). Root canal morphology and its relationship to endodontic procedures. *Endod Top*, 10, pp. 3-29.

[25] Verma, P. & Love, R.M. (2010). A micro CT study of the mesiobuccal root canal morphology of the maxillary first molar tooth. *International Endodontic Journal*, 44(3), pp. 210-217.

[26] Weine, F.S., Healey, H.J., Gerstein, H. & Evason, L. (1969). Canal configuration in the mesiobuccal root of the maxillary first molar and its endodontic significance. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 28, pp. 419-425.

Cone-Beam Computed Tomographic Study on Condylar Positions in Patients with Centric Relation-Maximum Intercuspation Discrepancy

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Abstract - **There have been studies regarding condylar positions associated with malocclusion and temporomandibular joint (TMJ). In centric relation-maximum inter-cuspation (CR-MI) discrepancy, the mandible shifts from CR to MI position to achieve occlusal stability. Although occlusal discrepancy can be observed directly in the mouth, condylar position is inaccessible to the naked eye. Knowledge of condylar position associated with CR-MI discrepancy is still scarce. Recently developed cone beam computed tomography (CBCT) allows measurement of TMJ with high accuracy. The aim was to study the condylar positions in patients with and without CR-MI discrepancy by using CBCT. The total sample involving 28 patients, age between 18-35 years, seeking orthodontic treatment at the Department of Orthodontics, were involved. In this cross-sectional comparative study, the samples were categorized into two groups as the subjects with and without CR-MI discrepancy by using clinical examination. CBCT images were scanned and then analyzed by OnDemand3D software. Five linear measurements: the anterior, superior, posterior, medial and lateral joint spaces and one angular measurement: the inclination of articular eminence were measured for right and left TMJ in each group. Statistical differences of intergroup and intragroup were assessed by Student's t test. There was no statistically significant difference of condylar positions in both intergroup and intragroup comparisons. Thus, the condylar position in patients with CR-MI discrepancy are not statistically significant from that in patients without CR-MI discrepancy. The condylar measurement alone is not a sufficient evidence for CR-MI discrepancy. Clinical examination of TMJ status, the existing occlusion altogether with CBCT imaging of condylar position will be great helpful for the clinician to diagnose how the patient's TMJ was affected by CR-MI discrepancy.**

Keywords; Condylar position, Centric relation, Maximum intercuspation, CBCT

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Introduction

Centric relation (CR) is defined as "the maxillary-mandibular relationship in which the condyles articulate with the thinnest avascular portion of their respective disks with the condyle in the anterior-superior position against the slopes of the articular eminence". Maximum intercuspation (MI) is defined as "the complete intercuspation of the

opposing teeth independent of condylar position" (The Glossary of Prosthodontic terms, 2005). Centric relation is the beginning of occlusion and the basis for all treatment modalities (Carroll *et al*., 1988). If the occlusion is not stable in the CR position, shifting will occur from the Centric relation positions to a more stable maximum intercuspation position. This shifting is called the CR-MI discrepancy (Lim *et al*., 2014).

A positive CR-MI discrepancy was defined as a discrepancy more than 1mm in the horizontal or vertical planes and more than 0.5 mm in the transverse plane following the criteria established by Slavicek and Crawford, that such discrepancies are clinically significant (He *et al*., 2010). Slides greater than 2mm are regarded as CR-MI discrepancy which have effects on temporomandibular dysfunction (TMD) and condylar position (Pullinger *et al*.,1993). Slides greater than 3 to 4 mm have been associated with increased incidence of the TMD symptoms (Graber *et al*., 2016).

An unstable occlusion produces compressive deflection of the condyle during interdigitation of the teeth. CR-MI discrepancies, if associated with joint compression, can lead to condylar resorption, especially in patients among those who are predisposed to more aggressive tissue response secondary to host factors (Arnett *et al*., 1996).

TMJ is a difficult area to investigate radiographically. Conventional radio-graphic methods show only the two-dimensional images and have limitations for accurately showing the anatomic characteristics of TMJ (Rodrigues *et al*., 2009). CBCT allows the measurement of the position of condyle in the glenoid fossa with high accuracy.

The purpose of this study was to compare the CBCT-based spatial analysis of the TMJ condylar position and to find the articular eminence angle as related to CR-MI discrepancy patients and individuals without CR-MI discrepancy. In addition to the importance of defining position of condyle in the fossa, condylar positions of individuals with and without CR-MI discrepancy can be applied for orthodontic treatment strategies. This information has not been reported yet with data obtained through CBCT imaging.

Materials and Methods

Cross-sectional comparative study was done among patients who attending the Department of Orthodontics, University of Dental Medicine, Yangon. Total of 28 patients, aged between 18-35 years, both genders were selected according to the selection criteria.

Subjects were screened for CR-MI discrepancy (n=14) by clinical examination. The condyles were guided to their most anterosuperior position in the fossa using a bilateral manual-manipulation technique (Graber *et al*., 2016). The jaws were passively manipulated to the first tooth contact. With the aid of a ruler, and compared to the position of the maxillary central incisors, the magnitude of movement of the mandibular central incisors from the CR to MI was visually assessed at the sagittal and transverse planes (Lim *et al*., 2014). Patients with clinically evident CR-MI discrepancy who had an incisor region discrepancy measuring greater than 2.0 mm in the sagittal and transverse plane were selected (Figure 1).

Alginate impressions of upper and lower teeth were taken and diagnostic study casts were fabricated with dental stone. CR wax bite was registered with double thickness of modelling wax and

then stored in cold water. Before mounting to the articulator, while in casts at MI position, 3 to 5 vertical continuous pencil lines were made by drawing between midline of upper incisors, and right and left mesiobuccal cusp tips of upper first molars and canines to their corresponding lower teeth. The casts were then mounted on an articulator in CR position with the aid of previously taken CR wax bite registration in order to assess the maximum intercuspation slides. The 'vertical lines apart' on articulated study casts was viewed as maximum intercuspation slides. Slides greater than 2 mm in transverse and sagittal planes were included in the CR-MI discrepancy group (Figure 2).

Figure 1. (A) Teeth at initial occlusal discrepancies associated with unilateral crossbite, (B) Occlusion in CR position recorded with CR wax bite

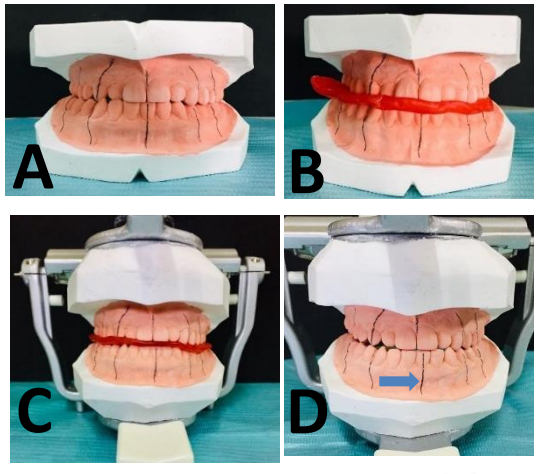


Figure 2. (A) Continuous pencil lines drawn in MI position, (B) Pencil lines apart on study models with CR wax bite, (C) Articulator mounted using CR wax bite, (D) Mounted articulator (to note the pencil lines apart)

For the group without CR-MI discrepancy (n=14), patients who had less than 2 mm CR-MI discrepancy with occlusions without crossbites and severe crowding were selected. Then, each and every participant was asked for consent to take CBCT images.

During CBCT scan, the patient was in standing position, with his head in natural head position, vision directed ahead. Teeth were clenched, ensuring maximum intercuspation (MI). A standard work protocol was used for equipment (Voltage- 89 kVp, current- 8 mA, field of view (FOV)- 13x15 cm). CBCT images were reconstructed and converted to DICOM (Digital Imaging and Communications in Medicine) images and imported into OnDemand3D software. Measurements were done at bilateral TMJ with slice thickness of 0.5 mm.

The axial view, in which the condylar process had the widest mediolateral diameter, was chosen as the reference view for secondary reconstruction. On this selected axial view, a line parallel to the long axis of the condylar process was drawn, connecting the condylar medial pole to its lateral one. Subsequently, the sagittal slices were obtained perpendicularly to the longitudinal axis of the mandibular condyle (Figure 3). The central sagittal slice, crossing the condylar midpoint, was considered to be the reference slice (Tsiklakis *et al*., 2004).

On the sagittal view, the true horizontal line (THL) passing the most superior aspect of glenoid fossa was used as the reference plane. The distance from the most superior condyle point (SC) to the most superior aspect of the glenoid fossa (SF) on the THL was measured as the superior joint space (SS). Lines tangent to the most prominent anterior and posterior aspects of the condyle was drawn from SF. Distances from the

anterior (AC) and posterior (PC) tangent points to the glenoid fossa were measured as the anterior joint space (AS) and posterior joint space (PS) (Figure 3).

To measure the articular eminence inclination, a tangent line was drawn from the uppermost point of the glenoid fossa (SF) to the anterior inclination of articular eminence. The angle between this line and a true horizontal line was defined as the articular eminence inclination (Figure 4) (Imanimoghaddam *et al*., 2016).

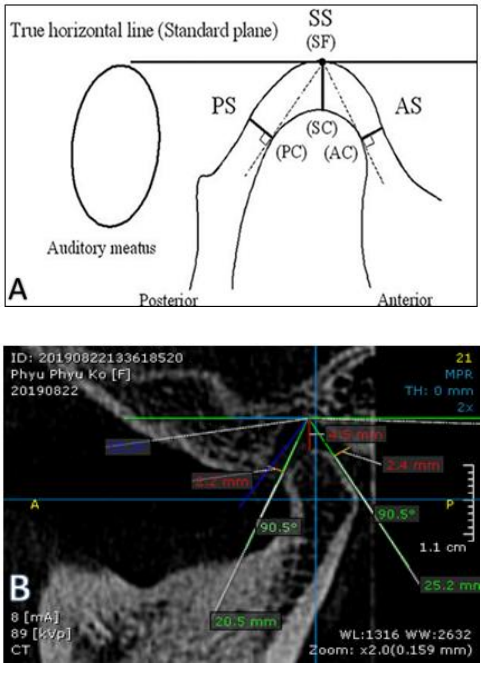


Figure 3. Sagittal measurements of anterior (AS), superior (SS) and posterior (PS) joint space (A) Schematic view (Shahi *et al.*, 2016), (B) CBCT view

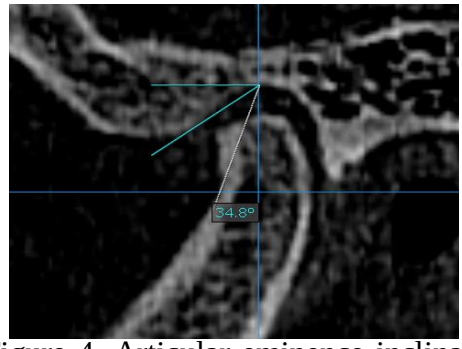
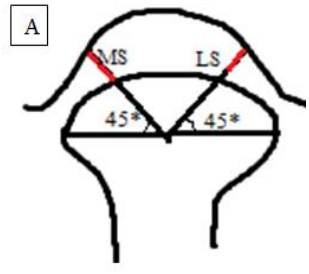


Figure 4. Articular eminence inclination measurement (CBCT view)

On the coronal view, for measuring the medial joint space (MS) and lateral joint space (LS) (Figure 5), the most medial and lateral points of the condyle were identified and a line was drawn. Its midpoint was considered to trace another two lines at 45 degree laterally and medially respectively. The intersection points of these lines with the condyle surface and glenoid fossa were determined and the distances in between were measured (Henriques *et al*., 2012).



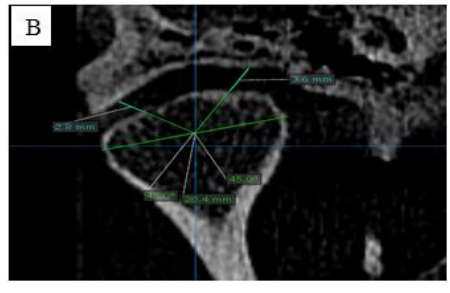


Figure 5. Coronal view measurements of medial (MS) and lateral (LS) joint space. (A) Schematic view, (B) CBCT view

All measurements were repeated after 2 weeks by the same investigator, and the mean of the 2 measurements were used in the statistical analysis. Data gathered from the measurements of left and right condyles were tabulated and organized to compare the anterior, superior, posterior, medial and lateral joint spaces, and articular eminence inclination between patients without CR-MI discrepancy (Group-I) and with CR-MI discrepancy (Group-II). This study was approved by ethical and research committee of University of Dental Medicine, Yangon.

Statistical Analysis

The linear and angular measurements of condylar positions in patients with and without CR-MI discrepancy were measured and the data were collected, analyzed and processed in the computerized Statistical Package for Social Science (SPSS) (version 22) program by using the descriptive statistics including mean and standard deviation. Then, differences between groups were determined by Independent Student's *t* test and Paired *t* test with statistical significance was considered at *p* less than 0.05.

Results

Table 1. Inter-group comparison of condylar position measurements between patients with and without CR-MI discrepancy (n=28)

Condylar position measurements		Patients without CR-MI discrepancy (Mean ±SD)	Patients with CR-MI discrepancy (Mean ± SD)	*p*-value*
Anterior joint space (mm)	Right TMJ	2.26 ±0.77	1.89 ± 0.81	0.224
	Left TMJ	2.30 ±1.41	2.61 ±0.29	0.422
Superior joint space (mm)	Right TMJ	3.47 ±1.41	2.91 ±1.11	0.258
	Left TMJ	3.36 ±1.12	3.44 ±1.09	0.859
Posterior joint space (mm)	Right TMJ	2.20 ±0.45	1.86 ±0.57	0.090
	Left TMJ	2.04 ±0.44	2.14 ±0.95	0.705
Articular eminence inclination (degree)	Right TMJ	44.39 ±10.33	38.67 ±6.64	0.093
	Left TMJ	43.35 ±8.97	42.35 ±6.98	0.745
Medial joint space (mm)	Right TMJ	3.32 ±0.98	3.03 ±1.16	0.487
	Left TMJ	3.29 ±1.38	3.20 ±1.23	0.869
Lateral joint space (mm)	Right TMJ	2.34 ±0.88	2.09 ±0.89	0.454
	Left TMJ	2.24 ±0.75	2.30 ±1.04	0.869

* Student's *t* test

Table 2. Intra-group comparison of condylar position measurements between right and left TMJ in patients without CR-MI discrepancy (n=14)

Condylar position Measurements	Mean difference (95% CI)	*p*-value*
Anterior joint Space (mm)	-0.04 (-0.52, 0.44)	0.862
Superior joint space (mm)	0.12 (-0.20, 0.42)	0.451
Posterior joint space (mm)	0.17 (-0.03, 0.37)	0.093
Articular eminence inclination (degree)	1.04 (-2.80, 4.88)	0.569
Medial joint space (mm)	0.03 (-0.42, 0.48)	0.879
Lateral joint space (mm)	0.10 (-0.18, 0.38)	0.457

* Paired *t* test

Table 3. Intra-group comparison of condylar position measurements between right and left TMJ in patients with CR-MI discrepancy (n=14)

Condylar position measurements	Mean difference (95% CI)	*p*-value*
Anterior joint space (mm)	-0.73 (-1.46, 0.01)	0.052
Superior joint space (mm)	-0.52 (-1.12, 0.08)	0.084
Posterior joint space (mm)	-0.28 (-0.73, 0.17)	0.202
Articular eminence inclination (degree)	-3.69 (-7.55, 0.18)	0.060
Medial joint space (mm)	-0.17 (-0.71, 0.37)	0.504
Lateral joint space (mm)	-0.21 (-0.81, 0.39)	0.464

* Paired *t* test

DISCUSSION

Cross-sectional comparative study was done to study the condylar positions in patients with and without CR-MI discrepancy by using CBCT among 28 patients (aged between 18-35 years) in Department of Orthodontics. The anterior, superior, posterior, medial, lateral joint spaces and articular eminence inclination of right and left TMJ were measured for intergroup and intragroup comparisons. It is important to have knowledge about the condylar positions in patients for planning of orthodontic treatment.

In this study, older subjects were excluded because they may have had the progressive degenerative bone changes that cause TMJ osteoarthritis. CR-MI discrepancy was examined at occlusal level and articulated study casts were used, a method that may be simpler and efficiently applicable to clinical orthodontics. Different imaging protocols were used while positioning patients during CBCT scan. Most of the previous studies used maximum occlusal intercuspation position, while some studies took patients both at MI and CR position (Ferreira *et al*., 2015; Lim *et al*., 2014) and others at edge to edge incisal relationship (Al-Rawi *et al*., 2017). In the present study, CBCT was taken with MI positions to understand the condylar positions influenced by occlusion.

The sagittal plane was considered as the most appropriate plane for assessing the condyle-fossa relationship (Kaur *et al*., 2016). In sagittal view, Ikeda and Kawamura (2009) evaluated the CBCT scans of 22 individuals in order to review the condylar position in asymptomatic patients and reported mean measures of anterior, superior and posterior measures were 1.3 mm, 2.5 mm and 1.6 mm respectively. Imanimoghaddam *et al*. (2016) reported the mean normal condylar measurements as 2.3 mm, 3.3 mm and 2.1 mm respectively. The present study measured the TMJ spaces of normal subjects without CR-MI discrepancy and mean right and left anterior joint space was around 2.26 and 2.3 mm, superior joint space 3.36 and 3.47 mm while posterior joint space was 2.04 and 2.20 mm showing that these findings were in accordance with Imanimoghaddam and differ from Ikeda. Differences would be expected because of racial diversity and variations in measurement techniques.

In this study, mean TMJ space measurement of patients with and without CR-MI discrepancy were not statistically significant (Table 1). The present study agreed with the results reported by Kim *et al*. (2013) who compared the condyle-fossa relationship in class III patients with and without facial asymmetry. They also found that measurements of TMJ spaces in sagittal view were not different between symmetric and asymmetric groups.

In the present study, no statistically

significant differences in eminence inclination were observed between normal and CR-MI discrepancy groups.

In coronal view, there were no significant differences of mean TMJ space measurements between the two groups (Table 1). These results showed that the condyles were concentrically positioned mediolaterally in the glenoid fossa irrespective of the CR-MI discrepancy. This may be due to the unequal distribution of mechanical stresses in the joint resulting in progressive remodeling of the condyle and mandibular fossa.

In sagittal view, although patients without CR-MI discrepancy (Table 2) and with CR-MI discrepancy (Table 3) show no significant difference between right and left side. However, side difference variations were slightly greater in CR-MI discrepancy group. The side difference in anterior joint space of patients with CR-MI discrepancy group were greater than in patients without CR-MI discrepancy group. This may be due to sample collection methods where subjects with anterior mandibular displacement were included in CR-MI discrepancy group.

Many researchers have proposed that the eccentric condyle position in the glenoid fossa is associated with TMD, osteoarthritic changes, remodeling of articular eminence and the condyle, whereas others have questioned its clinical significance because of the wide variations in the condyle position (Imanimoghaddam *et al.*, 2016). Although side variations of condyle position were found in both groups, those variations of CR-MI discrepancy were slightly larger than without discrepancy group. Thus, any eccentric condylar position should be considered in patients with CR-MI discrepancy.

Although this study had sample size limitation, as it was difficult to recruit subjects who had greater than 2 mm of mandibular incisor movement during the CR to MI change and because it was a research which dealt with radiation directly over human beings, the use of a sample of 28 individuals could be explained for the pilot character of this type of study, employing the cone beam method.

The present study did not demonstrate any significant differences in condylar position between patients with and without CR-MI discrepancy groups. Several different factors such as imaging technique used, accuracy of clinical examination, CR-MI discrepancy more than 2 mm regardless of large or small discrepancy, sample size, and the method of condylar position measurement can influence the results. Therefore, further cone beam computed tomographic studies are needed in this research area. Studies which include a large number of samples with normal patterns of occlusion, asymptomatic vs. symptomatic should be carried out.

CONCLUSION

According to this study, the mean condyle-fossa relationship in patients with CR-MI discrepancy was not statistically different from patients without CR-MI discrepancy. Bilateral differences was also found in patients without CR-MI discrepancy group while slightly greater differences were found in CR-MI discrepancy group. Therefore, bilateral condylar variation alone may not be a sufficient evidence for the CR-MI discrepancy. Clinical examination of TMJ status, the existing occlusion altogether with CBCT imaging of TMJ position and the shape of the condyle should also be considered.

COI

The authors declare there is no potential conflict of interest.

References

[1] Al-Rawi, N.H., Uthman, A.T. & Sodeify, S.M. (2017). Spatial analysis of mandibular condyles in patients with temporomandibular disorders and normal controls using cone beam computed tomography. *Eur J Dent*, 11, pp. 99-105.

[2] Arnett, G.W., Milam, S.B. & Gottesman, L. (1996). Progressive mandibular retrusion-idiopathic condylar resorption. Part II. *Am J Orthod*, 110, pp. 117-127.

[3] Carroll, W.J., Woelfel, J.B. & Huffman, R.W. (1988). Simple application of anterior jig or leaf gauge in routine clinical practice. *J Prosthet Dent*, 59, pp. 611–617.

[4] Ferreira, L.A., Grossmann, E., Januzzi, E., de Paula, M.V.Q. & Carvalho, A.C.P. (2015). Diagnosis of temporo-mandibular joint disorders: rational indication of imaging exams. *Braz J Otorhinolaryngol*, 292, pp. 1-12.

[5] Graber, L.W., Vanarsdall, R.L., Vig, K.W.L. & Huang, G.J. (2016). *Orthodontics: Current Principles and Techniques*. 6th Edition. Mosby Elsevier, St. Louis.

[6] He, S.S., Deng, X., Wamalwa, P. & Chen, S. (2010). Correlation between centric relation–maximum intercuspation discrepancy and temporomandibular joint dysfunction. *Acta Odontologica Scandinavica*, 68, pp. 368–376.

[7] Henriques, J.C.G., Fernandes Neto, A.J., Almeida, G.A., Machado, N.A.G. & Lelis, É.R. (2012). Cone-beam tomography assessment of condylar position discrepancy between centric relation and maximal intercuspation. *Brazilian Oral Research*, 26(1), pp. 29-35.

[8] Ikeda, K. & Kawamura, A. (2009). Assessment of Optimal Condylar Position with Limited Cone-Beam Computed Tomography. *Am J Orthod Dentofacial Orthop*, 135, pp. 495-501.

[9] Imanimoghaddam, M., Madani, A.S., Mahdavi, P., Bagherpour, A., Mansoreh, D., Darijani, M. & Ebrahimnejad, H. (2016). Evaluation of condylar positions in patients with temporomandibular disorders: A cone-beam computed tomographic study. *Imaging Sci Dent*, 46, pp. 127-131.

[10] Kaur, A., Natt, A.S., Mehra, S.K., Maheshwari, K., Singh, G. & Kaur, A. (2016). Improved visualization and assessment of condylar position in the glenoid fossa for different occlusions: A CBCT study. *J Contemp Dent Pract*, 17(8), pp. 678-686.

[11] Kim, H.O., Lee, W., Kook, Y.A. & Kim, Y. (2013). Comparison of the condyle-fossa relationship between skeletal class III malocclusion patients with and without asymmetry: a retrospective three-dimensional cone-beam computed tomography study. *Korean J Orthhod*, 43(5), pp. 209-217.

[12] Lim, W.H., Choi, B., Lee, J. & Ahna, S. (2014). Dentofacial characteristics in orthodontic patients with centric relation-maximum intercuspation discrepancy. *Angle Orthod*, 84, pp. 939–945.

[13] Pullinger, A.G., Seligman, D.A. & Gornbein, J.A. (1993). A multiple logistic regression analysis of the risk and relative odds of temporomandibular disorders as a function of common occlusal features. *J Dent Res*, 72(6), pp. 968-979.

[14] Shahi, A.K., Chandra, S., Rai, A. & Golwara. A. (2016). CBCT based comparison of condylar position in hypodivergent and hyperdivergent facial skeletal pattern. *International Journal of Contemporary Medical Research*, 3(2), pp. 468-472.

[15] The glossary of prosthodontic terms (2005). *J Prosthet Dent*, 94, pp. 10-92.
[16] Tsiklakis. K., Syriopoulos, K. & Stamatakis, H.C. (2004). Radiographic examination of the temporomandibular joint using cone beam computed tomography. *Dentomaxillofacial Radiology*, 33, pp. 196-201.

Application of Buccal Fat Pad for Lateral Palatal Defect in Cleft Palate Repair: Case Report

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***Abstract* - Cleft lip and palate is one of the most common deformities in the craniofacial skeleton. There are various methods used for cleft palate repair. The buccal fat pad (BFP) has been used in different kinds of surgeries. The use of the buccal fat pad in cleft palate repair has increased in popularity in recent years because of its reliability, ease of harvest and low complication rate. The purpose of this case report is to assess the utility of buccal fat pad as a pedicled graft for lateral palatal defect in cleft palate repair. In this case report, the patient had no postoperative complication correlated to buccal fat pad or donor site. The buccal fat pad healed well. This technique allows simple, safe and vascularized coverage of raw lateral palatal defect in cleft palate repair.**

Keywords; cleft palate repair, buccal fat pad, lateral palatal defect

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Introduction

Cleft lip and palate is one of the commonest congenital abnormalities of the head and neck region with worldwide incidence of 1 in 700 live births. Its incidence in the Asian population is reported to be around 2.0/1000 live birth or higher (Olasoji *et al*., 2005).

Various flaps have been used to cover defects in cleft palate surgery. However local flaps were associated with some disadvantages, including the need for a second surgical site, defect and scar contracture (Kim, 2001).

The use of buccal fat pad (BFP) to repair primary cleft palate was first described in Chinese by Zhao *et al.* (1998). The buccal fat pad consists of an encapsulated body with four extensions: buccal, pterygoid, superficial, and deep temporal and derives its blood supply from the buccal and deep temporal branches of the maxillary artery, transverse facial branches of the superficial temporal artery, and branches of the facial artery. Due to its rich blood supply, it can be considered as a pedicled graft in a poorly vascularized recipient site. It may also be one reason for the quick epithelialization of buccal fat pad (Stuzin *et al*., 1990).

Factors that might lead to hypoplasia and deformity of the maxilla include extensive dissection of the tissues and the healing of wounds by secondary intention. This is especially so after Bardach's two-flap palatoplasty, Von Langenbeck, and Veau Wardill Kilner's methods, in which the bones are denuded as a result of mucoperiosteal flaps transposition and the use of relaxing incisions. Most common complications of cleft palate repair especially in wide cleft palate are lateral palatal defects and oronasal fistula (Grobe *et al*., 2011).

In this case report, buccal fat pad was used as a pedicled graft for covering the lateral palatal defect during primary palatoplasty.

Case Report

One year and five months old male patient presented with complaint of nasal regurgitation. There was no significant past medical or family history. On general examination he had all normal parameters. On examination there was complete unilateral cleft palate. He was operated with Bardach' two flap palatoplasty under general anaesthesia. The patient was given antibiotic prophylaxis before incision.

Under general anaesthesia, the severity of cleft palate (palatal index) was measured just before surgery. The palatal index was 0.5 (severe cleft palate). Incision lines and site for buccal fat pad harvest were marked (Figure 1). For vasoconstriction, 1% lidocaine with 1: 200,000 adrenalin solutions were infiltrated along the proposed incision lines.

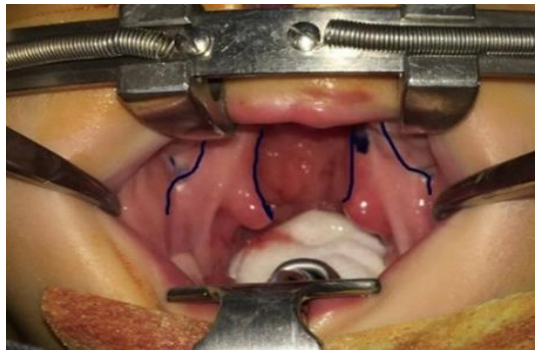

Figure 1. Marking for incision lines and site for buccal fat pad harvest

The mucoperiosteal palatal flaps were incised to the immediate posterior edge of the alveolar ridge, incorporating the entire oral mucosa of the anterior palate, which allows the closure to extend into the alveolar cleft. The lateral releasing incisions were made on the mucosa extending along the medial alveolus. Alveolar incision was extended behind the tuberosity for buccal fat pad harvest (Figure 2).

Figure 2. Elevated mucoperiosteum flap

The levator muscle dissection and reconstruction of muscle sling was performed. Closure was achieved in three layers (nasal, muscle and oral) with the use of 4/0 vicryl sutures in soft palate and two layers in hard palate (Figure 3).

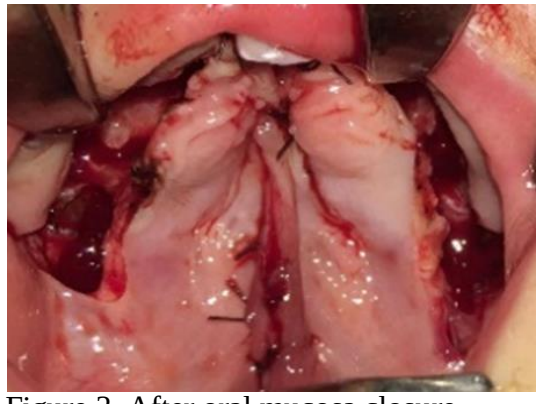

Figure 3. After oral mucosa closure

The buccal fat pad was gently exposed by blunt dissection with a curved hemostat through the surgical defect posterior to the maxillary tuberosity. The exposed buccal fat pad was mobilized by gentle teasing out of its bed until a significant amount was obtained to cover the defect without tension (Figure 4) and filled into the defect and sutured to the edge of the flap. The same procedure was done for another side. The buccal fat pad was left uncovered to heal and epithelialize

spontaneously (Figure 5). The patient was hospitalized for two days. Liquid diet was administered for three weeks. The patient was seen 1st day, 2nd day, 3rd day, 1st week, 2nd week, 3rd week and 4th week postoperatively.

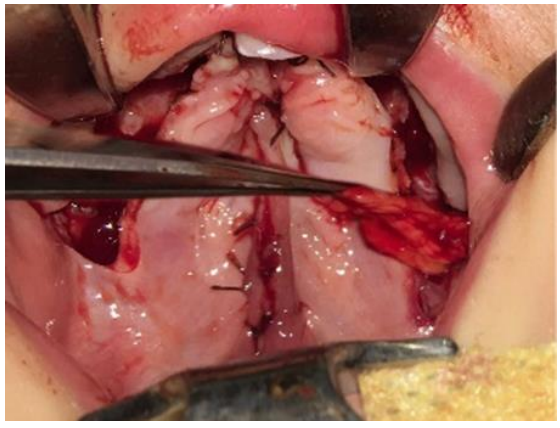

Figure 4. Buccal fat pad harvest

Figure 5. Lateral palatal defect filled with buccal fat pad

Results

There were no postoperative complications of palatoplasty correlating to the use of buccal fat pad such as facial nerve injury, Stensen's duct injury, bleeding, hematoma, wound dehiscence, wound infection, oronasal fistula and buccal fat pad failure. Complete epithelialization of buccal fat pad was observed on postoperative 4 weeks of inserts.

Discussion

The buccal fat pad is expected to provide a vascular tissue on raw surface lateral palatal defect so that the risk of post-operative complications can be reduced. In this case report, there were no postoperative complications of palate-plasty such as bleeding, haematoma, wound dehiscence, oronasal fistula and buccal fat pad failure. Extrusion of buccal fat pad was occurred on postoperative 2 weeks (Figure 6).

Figure 6. Extrusion of buccal fat pad on postoperative 2 weeks

There was no disturbance in occlusion and no need for snipping off protruding fat. Extruded fat progressively shrinked within two weeks (Figure 7).

Figure 7. Extruded fat progressively shrinked on postoperative 4 weeks

Clinically, the surface of the buccal fat pad turned from the typical fatty yellow to a paler yellow/white color after 3-4 days and gradually became red within a week. These processes possibly come from rich blood supply and fresh wound around the defect (Ladani & Sailer, 2016). In this case report, the surface of the buccal fat pad turned from the fatty yellow to a paler yellow color at postoperative 3rd day and became red on postoperative one week and had complete epithelialization on postoperative 4 weeks.

These findings are consistent with previous published study of Rapidis *et al*. (2000), found that harvesting of the BFP requires less donor site dissection, minimal donor-site morbidity and less postoperative complications.

Conclusion

Buccal fat pad is a reliable flap with good vascularity, simple to harvest, easy technique, proximity to surgical site and with low complication rate. As the result of this study, instead of leaving lateral defect raw surface in cleft palate surgery, buccal fat pad may be used for filling the gap which leads to better healing and least post-operative complications.

COI

The authors declare there is no potential conflict of interest.

References

[1] Grobe, A., Eichhorn, W., Hanken, H., Precht, C., Schmelzle, R., Heiland, M. & Blessmann, M. (2011). The use of buccal fat pad (BFP) as a pedicled graft in cleft palate surgery. *International Journal of Oral and Maxillofacial Surgery*, 40, pp. 685-689.

[2] Kim, Y.K. (2001). The use of a pedicled buccal fat pad graft for bone coverage in primary palatorrhaphy: a case report. *J Oral Maxillofac Surg*, 59(12), pp. 1499-1501.

[3] Ladani, P.S. & Sailer, H.F. (2016). Application of buccal fat pad for lining of lateral defect in cleft palate repair and review of literature. *Journal of Cleft Lip Palate and Craniofacial Anomalies*, 16(2), pp. 63-66.

[4] Olasoji, H.O., Ukiri, O.E. & Yahaya, A. (2005). Incidence and etiology of oral clefts, a review. *Afr J Med*, 34, pp. 1-7.

[5] Rapidis, A.D., Alexandridis, C.A., Eleftberiadis, E & Angelopoulos, A.P. (2000). The use of the buccal fat pad for reconstruction of oral defects: review of the literature and report of 15 cases. *J Oral Maxlllofac Surg*, 58, pp. 158–163.

[6] Stuzin, J.M., Wagstrom, L., Kawamoto, H.K., Baker, T.J. & Wolfe, S.A. (1990). The anatomy and clinical applications of buccal pad of fat. *Plast Reconstr Surg*, 85, pp. 29-37.

[7] Zhao, Z., Li, S. & Li, Y. (1998). The application of the pedicled buccal fat pad graft in cleft palate repair. *Chinese journal of plastic surgery and burns*, 14(3), pp. 182-185.

3D Printing Removable Complete Denture: A Case Report

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Abstract **- The speedy development of computer-aided design (CAD) and 3D printing (Rapid Prototyping - RP) technology brings many advantages to today dentistry, which provides better predictability of the desired outcomes and high accuracy. Moreover, it eliminates some laboratory steps and materials errors. A 74 years old edentulous male patient presented to the Department of Prosthodontics with chief complaint of masticatory problem. Patient was screened according to the protocol that took into account his general health and treatment possi-bilities. Both ridges were unfavorable. After obtaining consent from the patient, it was decided to construct a complete denture. The presented work-flow for complete denture fabrication is combination of conventional and digital. The master casts retrieved from the zinoxide eugenol final impressions were scanned with laboratory scanner (Trios E3, Denmark) at Digital Dental Laboratory of UDMY. Jaws relation was registered with record blocks which were made by 3D printed permanent base plates and wax rims. Then, registration was scanned and virtually mounted in articulator in CAD software. Complete denture was designed and then fabricated by 3D printer (Asiga, Australia). The outcomes of 3D printed complete dentures were analyzed in terms of retention, stability, denture occlusion, appearance and patients' satisfaction. Overall outcomes are satisfactory. This case report is the preliminary step which encourages researchers and clinicians to consider digital processing in fabrication of complete denture.**

Keywords; digital denture workflow, 3D printing denture, complete denture base

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Introduction

The computer aided design and computer aided manufacturing (CAD/ CAM) technology became one of the most important developments happened in the dental field in the twenty-first century. Furthermore, the additive rapid prototyping technologies can fabricate organic complex configurations which were very difficult to be milled with subtractive method. Consequently, it is suitable for human anatomy structures and highly detailed prosthetic appliances such as removable complete denture, partial denture, maxillo-facial prosthesis and implant surgical guide stents (Beuer *et al.*, 2008).

The speedy development of computer-aided design (CAD) and 3D printing (Rapid Prototyping- RP)

technology brings many advantages to today dentistry, which provides better predictability of the desired outcomes and high accuracy. Moreover, it eliminates laboratory steps and errors, materials errors as well. Digital workflow starts with digital impression by digitizing the oral structures, either directly or indirectly, with intraoral or laboratory scanner, respectively. The direct method is scanning the oral cavity, whereas the indirect method is scanning an impression or cast. The digital data obtained from the scans are converted into standard tessellation language (STL) file, a format compatible with computer software, and then restorations can be directly produced (Park & Shin, 2017). It could provide virtual plan and design directly on the 3D model. After the design is completed, the software will digitally export the designed framework files which can be used for the additive or subtractive manufacturing of the frameworks (Ye *et al*., 2017). Dentistry has had a long association with subtractive manufacturing such as milling, 3D printing has opened new possibilities of manufacturing which are impossible with subtractive manufacturing (Dawood, 2015). Additive manufactured 3D printing techniques include stereolithography, digital light projection (DLP), jet printing, fused deposition modeling (FDM), and selective laser melting (SLM) (Azari, 2009).

The stereolithography technique uses ultraviolet (UV) lasers for polymerization of photosensitive resin materials in small layer thicknesses ranging from 10 mm to 100 mm depending on the accuracy desired. This technique is used to manufacture a wide variety of objects, including dental casts, resin wax patterns, resin RPD frameworks, interim restorations, removable complete denture-base material, denture teeth, and surgical guides (Revilla, 2018). DLP has a similar accuracy and range of uses but is a much faster technology and can polymerize an entire layer. Postprint polymerization is used for both DLP and stereolithography with a light-emitting diode UV light source to ensure complete polymerization and biocompatibility (Dawood, 2015). DLP is commonly used in dental 3D printing systems because of high accuracy and faster technology.

Case Description

A 74 years old edentulous male patient presented to the Department of Prostho-dontics, University of Dental Medicine, Yangon (UDMY) with chief complaint of masticatory problem. Patient was screened according to a protocol that took into account his general health and treatment possibilities. Both ridges were unfavorable. After obtaining consent from the patient, it was decided to construct a complete denture.

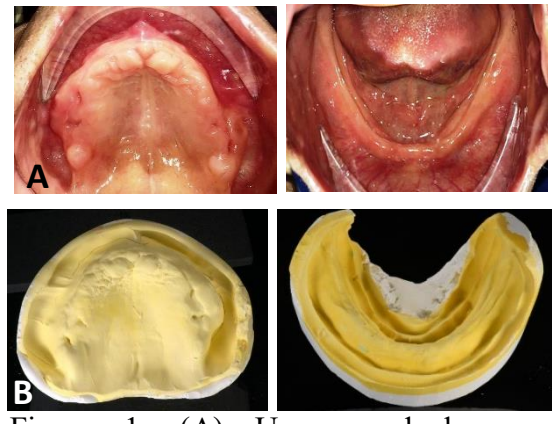

Figure 1. (A) Upper and lower edentulous ridges (B) Master casts for

First, primary impression was made with standard perforated metal rim lock stock tray and impression compound material. The stone cast was poured and secondary impression was made using irreversible hydrocolloid (alginate)

impre-ssion material and spaced individual tray. Then diagnostic cast was poured and TRP (Tissue Reflection Point) line was drawn on it. Final impression was made using closed-fitting individual tray constructed with autopolymerizing tray material and zincoxide eugenol wash impression material. Record blocks were fabricated with permanent base plates by using 3D printer (Asiga, Australia) and wax rims. Then, jaws relation registration was performed. The upper and lower master stone casts and bite registration were extraorally digitalized with a laboratory scanner (Trios E3, Denmark).

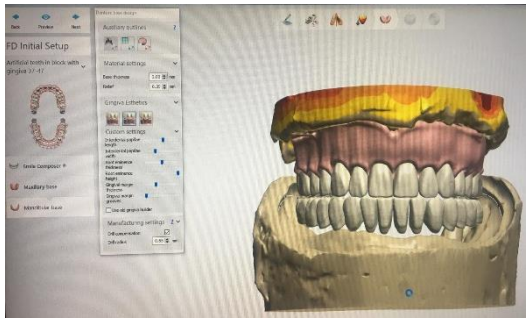

Figure 2. CAD designing dentures on virtual mounting

Virtual mounting and artificial teeth setting up were arranged using CAD software. Complete denture bases were designed according to the data obtained from the scanner and data were transported to 3D printer (Asiga, Australia) to fabricate 3D resin denture base by digital light projection (DLP) technology. Resin teeth set was fabricated based on the scan data of bite registration and bonded to the denture base. All laboratory works were performed at Digital Dental Laboratory of UDMY.

Evaluation of retention and stability

On the day of delivery, retention and stability of digital complete denture were assessed by Kapur's method (1967). Denture retention was evaluated by placing the thumb and index fingers on the labial and lingual side of the central incisor teeth. A vertical pulling force was applied along the path of insertion. Stability was evaluated by placing the thumb and index fingers on the buccal surface of the premolar teeth, and the denture was moved horizontally, antero-posteriorly, and mediolaterally. It was recorded as very good retention and stability.

Evaluation of denture occlusion

Denture occlusion was checked by chewing articulating paper on both sides and no heavy localized occlusal contacts were found. The patient didn't complaint of any occlusal interference and lesser occlusal adjustments were necessary.

Evaluation of patients' satisfaction

Overall patients' satisfaction was measured by using Smith's questionnaires (1976) which include retention, appear-ance, chewing satisfaction, comfort and general satisfaction with experiment denture at the time of delivery. It was found that 3D printed denture provided very good satisfaction score.

Figure 3. 3D printing complete denture bases and artificial teeth

Discussion

Digital denture processing offer speed, efficiency, ability of storing

captured information and transferring digital images between dental office and the laboratory (Kim, 2013). CAD system provides virtual planning and designing of prosthesis with repeatability. The design data may be saved for future use should there be a need to refabricate or modify the prosthesis. In addition, the total time of prosthesis fabrication is substantially reduced by eliminating some laboratory processes. These advantages highlight the benefits of the digital over the conventional method (William, 2004). The digital fabrication method leads to lesser steps, more accurate and reduces complexity, less possible error, time consuming then it also allows better communication with technician. It can give the lower distortion, higher precision and high quality of surface finishing. Santler *et al*. (1998) concluded that digital fabrication method improves quality of denture framework. The framework fabricated by digital workflows decrease inaccuracies, cast and wax errors, human errors, hand-made way of working which makes the results vulnerable, on the other hand, accuracy achieved by master casts scanning, and virtual design also allows operators to modify and adjust unsatisfactory contents conveniently and 3D digital printing helps to avoid possible human and material errors.

Recommendation

On analyzing the outcomes of this case, 3D printed complete denture is generally satisfactory. This case report is the preliminary step which encourages researchers and clinicians to consider digital processing in fabrication of complete denture.

COI

The authors declare there is no potential conflict of interest.

Figure 4. Intraoral views of upper and lower 3D printing complete denture in position

References

[1] Azari, A. & Nikzad, S. (2009). The evolution of rapid prototyping in dentistry. *Rap Proto J*, 15, pp. 216-225.

[2] Beuer, F., Schweiger, J. & Edelhoff, D. (2008). Digital dentistry; an overview of recent developments for CAD/CAM generated restoration. *Br Dent J*, 204, pp. 505-511.

[3] Dawood, A., Marti, B.M. & Sauret, J.V. (2015). 3D printing in dentistry. *Br Dent J*, 10, pp. 286-291.

[4] Kapur, K.K. (1967). A clinical evaluation of denture adhesives. *J Prosthet Dent*, 18, pp. 550-558.

[5] Kim, S.Y., Kim, M.J., Han, J.S., Yeo, I.S., Lim, Y.J. & Kwon, H.B. (2013). Accuracy of dies captured by an intraoral digital impression system using parallel confocal imaging. *J Prosthodont*, 26(2), pp. 161-163.

[6] Park, M.E. & Shin, S.Y. (2017). Three-dimensional comparative study on accuracy and reproducibility of dental casts fabricated by 3D printer. *J Prosthet Dent*, 119(5), pp. 861.

[7] Revilla, L.M. & Özcan, M. (2018). Additive manufacturing technologies used for processing polymers: current status and potential application in prosthetic dentistry. *J Prosthodont*, 28(2), pp. 146-158.

[8] Santler, G., Karcher, H., Gaggl, A. & Kern, R. (1998). Stereolithography versus milled three-dimensional models: comparison of production method, indication and accuracy. *Comput Aided Surg*, 5, pp. 248-56.

[9] Smith, M. (1976). Measurement of personality traits and their relation to patient satisfaction with complete dentures, *J Prosthet Dent*, 35, pp. 492–503.

[10] Williams, R.J., Bibb, R. & Eggbeer, D. (2004). CAD/CAM in the fabrication of removable partial denture frameworks: a virtual method of surveying 3D scanned dental casts. *Quintessence J Dent Technol*, 2, pp. 268-276.

[11] Ye, H., Ning, J., Li, M., Niu, L., Yang, J. & Sun, Y. (2017). Preliminary clinical application of removable partial denture frameworks fabricated using computer-aided design and rapid prototyping techniques. *Int J Prosthodont*, 30, pp. 348-53.

Parry-Romberg Syndrome: Case Report

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Abstract- **Parry-Romberg syndrome (PRS) also known as progressive facial hemiatrophy is a rare neurocutaneous disorder of unknown aetiology characterized by slowly progressive shrinkage and degeneration of skin, subcutaneous tissue and sometimes adjacent craniofacial bones, usually on only one side of face but occasionally extending to other parts of the body. It frequently overlaps with linear scleroderma 'en coup de sabre', which appears as a depressed linear scar on affected area. This syndrome has a self-limiting behavior but may develop neurologic or ophthalmologic symptoms with variable prognosis in some cases. Inconsistency in clinical presentation has made it quite challenging to diagnose, prognosticate, and treat. A 35 years old lady presented with complaint of progressive left facial hemiatrophy within 2 years. On examination, facial asymmetry was noted with linear scleroderma 'en coup de sabre' along lower third of left side of the face, sparing nose and eye without neurological and ocular symptoms. Not much has been known about the clear aetiology and pathophysiology of this syndrome and there is no curative therapy. The aesthetic concerns to facial dis-figurement as well as systemic and psychological problems necessitate multidisciplinary team approach to identify patient's expectations and treat the conditions.**

Key words; Linear scleroderma, Parry-Romberg syndrome (PRS), progressive facial hemiatrophy

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Background

Parry-Romberg syndrome (PRS), also known as progressive facial hemiatrophy, is a rare, insidious, and self-limiting hemiatrophy of the face. It characteristically involves the skin, subcutaneous fatty tissue, muscle, connective tissues and may later progress to affect the cartilage, and osseous structures with or without development of neurologic symptoms (Wong *et al*., 2015). The disease was first described by Caleb Hillier Parry in 1825 and Moritz Henirich Romberg in 1846. The term "progressive facial hemiatrophy" was first used by Eulenberg in 1871 (Khan *et al.,* 2014).

Parry-Romberg syndrome typically presents initially in children and young adults and slowly progresses over a highly variable course ranging from 2 to 20 years, eventually reaching a "burned-out phase" and stabilizing for no apparent reason. The onset may be as late as 40 years in some patients. Patients with early onset tend to be more severely affected. The severity of facial atrophy ranges from slightly noticeable asymmetry to severe disfigurement (Maletic *et al.,* 2010).

This condition is more commonly seen in women with a female to male

ratio of 3:2. It affects the face unilaterally in 95% of cases, mainly left side. The incidence rate was 1 in 700,000 subjects. It may be associated with neurological, cutaneous, ocular, dental and autoimmune abnormalities. Congenital manifestations associated with PRS are contralateral Poland Syndrome, congenital lower limb hypoplasia, congenital ipsilateral cerebral atrophy, lipodystrophies, micropthalmia and renal malformations. Sometimes, it may be related with hypertrophic cardiomyopathy, hypo-thyroidism, rheumatoid arthritis, lupus erythematosus and scleroderma. Due to the rarity of the disease and difficulty in identifying its clinical features, PRS is often underdiagnosed or misdiagnosed (Sharma *et al.,* 2012).

The exact aetiology is unknown but the possible suggested factors are local facial trauma, genetic factors, autoimmunity, endocrine disturbances, peripheral trigeminal neuritis, hyperactivity or hypoactivity of cervical sympathetic nerve activity, trauma to superior cervical ganglia, infections (viral and bacterial- *Borrelia burgdorferi*) and cerebral disturbance of fat metabolism (Alaizari *et al*., 2015).

There are two grading systems for clinical severity of PRS. The grading system by Inigo *et al*. (1993) (Table 1) is based on the involvement of tissues in the region of the trigeminal nerve (dermatomes) whereas the classification by Gurrerrosantos *et al*. (2007) (Table 2) is based on clinical progression of disease, independent of the affected dermatome. But the severity of deformity does not reflect the quality of life (Amaral *et al*., 2014).

Neurologic symptoms occur in 15-20% of patients, including ipsilateral headaches, facial pain, seizures, trigeminal neuritis, facial paresis, cranial nerve dysfunction, fixed focal neurologic defects, hemiparesis and cognitive impairment (Moko *et al*., 2003).

Ophthalmologic symptoms occur in 10-35% of patients and usually involve ipsilateral orbit. Enophthalmos is common due to atrophy of the retrobulbar fat. Other abnormalities include uveitis, retinal or optic nerve alterations, glaucoma, restrictive strabismus, endothelial precipitates, Horner's syndrome or ophthalmoplegia (El-Kehdy *et al*., 2012).

Hemiatrophy of the arm, trunk or leg ipsilaterally or contralaterally may be present in some patients. Skin and hair disorders including dryness, hyperpigmentation or vitiligo and band-like alopecia were also reported. There may be demarcation line between normal and abnormal skin (en coup de sabre) (Chiang *et al*., 2009).

Table 1. Inigo *et al*. (1993) classification of PRS

Mild	Atrophy of skin and subcutaneous tissue in the region of one branch of the trigeminal nerve, with no bone involvement
Moderate	Involvement of the skin, subcutaneous tissue in two branches of the trigeminal nerve, with no involvement of the orbital bone region or maxillomandibular growth
Severe	Atrophy of the skin in the three branches of the trigeminal nerve, with bone involvement

Table 2. Guerrerosantos *et al*. (2007) classification of PRS

Type 1	Very mild depression, occurring in acute phase of Parry-Romberg syndrome
Type 2	Reduced thickness of the soft tissue, with no bone or cartilage involvement
Type 3	Soft tissue thinner than in type 2; initial bone and cartilage involvement
Type 4	The most severe form of facial depression; in many cases the skin is quite close to the bone and there is bone involvement

Oral manifestations are unilateral tongue atrophy, jaw hypoplasia, wasting of muscles of mastication, hemimasticatory muscle spasms, short roots on affected side, deficiency of hard and soft palate, delayed ipsilateral tooth eruption and unilateral cross-bite (Abdelnour *et al.*, 2019).

Case Report

A 35 years old lady with progressive left hemifacial atrophy within 2 years came to dental outpatient department, 500-bedded Bago General Hospital for aesthetic and psychological concerns, but without any functional problems.

Last 2 years, she first noticed black pigmentation of skin associated with gradual shrinkage of left side of cheek. She went to private dental clinic for her sunken face and took fixed dental prosthodontics treatment to replace lost lower left first permanent molar, extracted at her age of 16 years. However, the facial asymmetry became more severe and she visited to orthopaedic surgeon and many general medical practitioners for seeking treatment. One of the medical practitioners referred her to our dental department.

She had no history of trauma, burn, cutaneous abscess, pathological lesion or surgery at that site. She also had no family history of similar lesion or connective tissue disorder. She had no history of migraine, facial pain, hair loss, epilepsy or visual problems.

On examination, the patient's general condition was fair. Extraorally, facial asymmetry was noted due to mild depression and thinning of skin, associated with linear scleroderma 'en coup de sabre' of left side of cheek extending from chin along inferior border of mandible to preauricular region (Figure 1). No numbness, no pain, no rigid in consistency, and no decreased sensation were noted at affected area.

There were no limitation of mouth opening and no deviation during mouth opening (Figure 2). On intraoral examination, intact dentition with fixed dental prostheses at lower left posterior teeth, no dental arch asymmetry, no tongue atrophy and no underlying pathology such as sinus tract, tumor and osteomyelitis were noted clinically.

Ophthalmologic examinations showed no abnormal pathologies such as enopthalmos, uveitis, episcleritis, cataract, glaucoma, epithelial calcifications and vision problems, except reduced 6/6 acuity. According to ophthalmoscopy, the fundus and retina were found to be no signs of abnormalities.

Investigation results revealed that complete blood count, erythrocyte sedimentation rate (ESR), urea and electrolytes, creatinine and liver function tests were within normal limits. But antinuclear antibody (ANA) profile with speckled and homogenous pattern 1/400 dilution was positive. Posteroanterior

(PA) view of mandible revealed there was an asymmetry between right and left side with atrophy at left mandible up to condylar region, not associated with abnormal bony pathology (Figure 3).

Skin biopsy at left cheek reported that there were hyperkeratosis and focal vacuolar degeneration of basal layer with presence of dermal thick collagen fibers and mono-nuclear inflammatory cellular infiltration. These features were consistent with linear scleroderma overlapping PRS.

Figure 1. Photographs showing facial asymmetry, mild depression and thinning of skin, associated with 'en coup de sabre' of left side of cheek involving mandibular region

Figure 2. Photographs showing no limitation of mouth opening and no dental crossbite

Figure 3. Posteroanterior (PA) view of mandible showing atrophy at left side of mandible

Contrast enhanced computed tomography CECT scan of head showed no abnormal pathology and mass were noted at brain and its components (Figure 4).

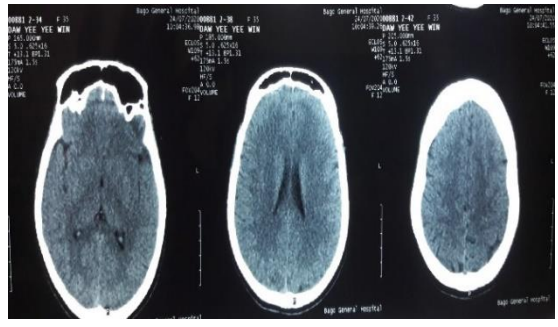

Figure 4. CT scan showing normal brain

Left sided subcutaneous facial atrophy was noted at mandibular region. Muscle planes were intact. No enhancing focal lesion was seen. No bony lytic or sclerotic lesion was seen in mandible. Ill-defined bony sclerosis with no obvious erosion was noted at left maxillary bone. There was no surrounding soft tissue edema formation. Parotid and submandibular glands were normal on both sides. No evidence of regional lymphadenopathy was seen at anterior and posterior triangles of the neck (Figure 5).

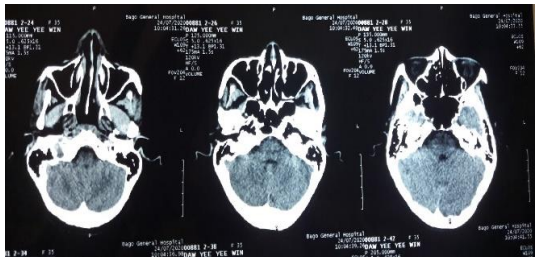

Figure 5. CT scan showing left sided subcutaneous facial atrophy at mandibular region and sclerosis of maxillary bone at left side

Discussion

Parry-Rhomberg syndrome (PRS) is a rare and sporadic condition which affects mainly female and usually at left side of the face. The disease onset commences before 15 years of age in 71% of patients and only 8% had an onset after 25 years of age (Abdelnour *et al*., 2019). Our patient was 35 years old and said to be involved in 8% of patient population and she suffered left sided facial hemiatrophy.

Differential diagnosis of localized scleroderma, hemifacial microstomia, Bell's palsy, unilateral ankylosis, hemifacial hypertrophy and trauma or burn scar can be considered (Khan *et al*., 2014). Diagnosis of PRS mainly relies on clinical history, examination and exclusion of other possibilities supported by imaging, histopathologic studies and laboratory findings (Wong *et al*., 2015). According to history, clinical features, imaging and histopathological findings, she was likely to have PRS. Moreover, she was ANA positive and the aetiology was likely to be related with autoimmunity.

On radiologic assessment, common facial imaging findings include varying degrees of hemiatrophy accompanied by obliteration of fat planes, ipsilateral deviation of the aerodigestive tract, and enophthalmos due to loss of retrobulbar fat (Sharma *et al*., 2012). Intracranially, the most common findings are the following: 1) ipsilateral linear or discrete subcortical calcifications in the frontal lobe, and 2) white matter hypo-attentuation on CT with ipsilateral focal or hemispheric brain atrophy. Less frequently, the loss of cortical gyration, cortical thickening, ventricular dilation, focal corpus callosum infarcts, lepto-meningeal thickening and contrast enhancement, attenuated mineral deposits, hamartomas were seen. Vascular abnormalities such as micro-hemorrhages, malformations, stenoses, and aneurysms have also been reported in association with PRS (Pichiecchio *et al*., 2002)

No standard treatment algorithm currently exists for PRS, especially given that response to treatment is difficult to assess. In general, treatment goals are to provide symptomatic relief, halt disease progression and improve cosmetic results. In regarding with treatment, there is no cure although immunosuppressive drugs and re-constructive surgery have been used with considerable results. Immunosuppressive therapies, ranging from topical corticosteroids to systemic cortico-steroids, immunosuppressive drugs (methotrexate, cyclophosphamides), immunomodulators, and plasmapheresis, have been used with varying degrees of success. Antimalarials, antibiotics, vitamin D3 analogues, retinoids and penicillamine are also treatment options that have demonstrated variable responses (Tollefson & Witman, 2007).

Once the disease stabilizes, reconstructive techniques were aimed for volume restoration and majority of patients undergo multiple procedures to correct facial asymmetry. The techniques involve fascia grafts, muscle grafts,

pedicle flaps, microvascular free flaps, medpor implants, bone augmentation and free fat grafts - injection of aspirated autologous fat and alloplastic graft materials (silicone). Autologous fat injections and biomaterials are generally used for small to moderate defects. For large volume correction, free flap procedures are preferred. Recently, combination of fat cells with platelet gel and autologous fat grafting with adipose-derived stem cells are popular for aesthetic correction of facial atrophy with the most favorable cosmetic results (Palmero *et al*., 2010).

According to Inigo *et al*. (1993) classification of PRS, the grading of our patient was moderate in category, atrophy of skin and subcutaneous tissue in left mandibular region, with bone involvement such as atrophy of mandibular bone and sclerosis of maxillary bone. Facial asymmetry, mild depression and thinning of skin of left cheek without motor and sensory deficits were noted. Moreover, it was not associated with neurological, ocular and severe systemic conditions.

Although ANA antibody was positive, she didn't suffer any rheumatological and autoimmune symptoms such as joint pain, fatigue and skin problems. So, the physician decided to wait and see without giving any immunosuppressant or other medication. Concerning with reconstructive surgery, risks and benefits of various treatment options have been explained to the patient and her relatives but they were not willing to take treatment at the moment and promised to come regular monthly visits. Her follow up period had been 6 months up to now and no progression of the condition was noted.

Conclusion

More than an aesthetic concern, this disease brings several functional and psychological problems due to asymmetry of face. Moreover, it is frequently associated with other systemic conditions - ocular, neuro-logical, metabolic and autoimmune problems. Multidisciplinary approach of specialist team (paediatrician or internist, oral and maxillofacial surgeon or plastic surgeon, dentists, opthalmologists, dermatologists, neurologists and other health care professionals) is required to give treatment to an affected individual systematically and comprehensively.

Recommendation

The dentist may be the first person to see this kind of patient with facial asymmetry. PRS may be one of the factors to be considered and not be overlooked to provide better quality of life to patient.

COI

The author declares there is no potential conflict of interest.

References

[1]Alaizari, N., Azzeghaiby, S.N., Alshamiri, H.M., Darwish, S. & Tarakji, B. (2015). Oral manifestations of Parry-Romberg syndrome: a review of literature. *Avicenna Journal of Medicine*, 5(2), pp. 25-28.

[2] Abdelnour, J.G.W., Abdelnour, Y.G.W., Kerollos, R.A.B. & Mahmoud, Z.I.T. (2019). Parry-Romberg syndrome associated with en coup de sabre in a patient from South Sudan - a rare entity from East Africa: a case report. *Journal of Medical Case Reports*, 13, pp. 133-138.

[3] Amaral, C.E.P.D., Denadai, R., Buzzo, C.L. & Amaral, C.E.P.D. (2014). Therapeutic approach to the Parry-

Romberg syndrome based on a severity grading system. *Brazilian Journal of Plastic Surgery*, 29(1), pp. 57-65.

[4] Chiang, K.L., Chang, K.P., Wong, T.T. & Hsu, T.R. (2009). Linear scleroderma "en coup de sabre": initial presentation of as intractable partial seizures in a child. *Pediatr Neonatol*, 50(6), pp. 294-298.

[5] El-Kehdy, J., Abbas, O. & Rubeiz, N. (2012). A review of Parry-Romberg syndrome. *Journal of American Academy of Dermatology*, 67, pp. 769-784.

[6] Guerrrerosantos, J., Guerrrerosantos, F. & Orozco, J. (2007). Classification and treatment of facial tissue atrophy in Parry-Romberg disease. *Journal of Aesthetic and Plastic Surgery*, 31(5), pp. 424-434.

[7] Inigo, F., Rojo, P. & Ysunza, A. (1993). Aesthetic treatment of Romberg's disease: experience with 35 cases. *British Journal of Plastic Surgery*, 46(3), pp. 194-200.

[8] Khan, M., Khan, M., Negi, R. & Gupta, N. (2014). Parry-Romberg syndrome with localized scleroderma: a case report. *J Clin Exp Dent*, 6(3), pp. 313-316.

[9] Maletic, J., Tsirka, V., Ioannidies, P., Karacostas, D. & Taskos, N. (2010). Parry-Romberg syndrome associated with localized scleroderma. *Case Reports in Neurology*, 2(1), pp. 57-62.

[10] Moko, S.B., Mistry, Y. & Blandin, T.M. (2003). Parry-Romberg syndrome: intracranial MRI appearances. *Journal of Craniomaxillofacial Surgery*, 31(1), pp. 321- 324.

[11] Palmero, M.L., Uziel, Y., Laxer, R.D.M., Forrest, C.R. & Pope, E. (2010). En coup de sabre scleroderma and Parry-Romberg syndrome in adolescents: surgical options and patient-related outcomes. *Journal of Rheumatology*, 37(10), pp. 2174-2179.

[12] Pichiecchio A., Uggetti C. & Egitto M.G. (2002). Parry-Romberg syndrome with migraine and intracranial aneurysm. *Neurology*, 59, pp. 606-608.

[13] Sharma, M., Bharatha, A. & Antonyshyn, O.M. (2012). Case 178: Parry-Romberg syndrome. *Radiology*, 262(2), pp. 721-724.

[14]Tollefson, M.M. & Witman, P.M. (2007). En coup de sabre morphea and Parry-Romberg syndrome: a retrospective review of 54 patients. *J Am Acad of Dermatol*, 56, pp. 257-263.

[15] Wong, M., Phillips, M., Hagiwara, M. & Shatzkes, D.R. (2015). Parry Romberg syndrome: 7 cases and literature review. *American Journal of Neuroradiology*, 36(1), pp. 1355-1361.